Technical Description

GPS satellite clock

6842

hopf Elektronik GmbH

Version 04.00 **26.02.2001**

Safety information

The safety regulations and technical data are important for the smooth running of the devices and the protection of people and equipment. Strict compliance with these regulations is required. In case of non-compliance with these regulations the guarantee and warranty claims for the device and possible consequential damage expire.

Safety of the Devices

The production of this device follows the latest technological standards and safety regulations.

The device must not be assembled by anyone but trained personnel. Please make sure that all the connected cables are laid and fixed properly. The device is to be run with the supply voltage stated on the identification plate only.

Only trained personnel or specialists may operate the device.

Repair on opened devices must not be carried out by anyone but specially trained staff or by the **hopf** company.

If the maintenance work requires the opening of a device or if a fuse needs changing the device must be separated from all voltage supplies.

If there are reasons to believe that the operational safety can no longer be guaranteed the device must be taken out of service and labelled accordingly. The safety may be impaired when the device does not operate properly or if it is obviously damaged.

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1 Brief Description Model 6842

The circuit board 6842 is a further development of the satellite radio controlled clock system 6840. When built into a system it can execute extended functions i.e. controlling a LAN-connection etc.

The measurements of the circuit boards correspond to the euro-format 100 mm x 160 mm. Particular care has been taken of the following features.

- potential separate antenna circuit
- no line length loss due to feeding in of indirect lightning protection
- antenna cable up to 150 m by simple cascading of an amplifier without own voltage supply into the antenna cable
- all settings can be parametered by serial interface

The device is configured by means of a key-pad on the front panel of the board by simple menu selection. The voltage supply and the signal transfer occur at a 64-pole VG-strip (DIN 41612 a/c inserted).

The voltage supply +5V DC / 1A is required.

At the exit the following signals are at hand:

- 1 PPS-pulse on TTL level
- 1 kHz square signal on TTL level
- 2 independent serial interfaces with handshake lines in RS232 and RS422 hardware
- 1 optical interface for either plastic or optical fibre
- DCF77[1] simulation
- variable pulse width for the DCF77 simulation

Board 6842G10

This identification number can be used to order this board as a spare part for the following radio controlled clock systems.

SYTEM 6842G01

Stand-alone system built in a ½ 19" module. As a standard it requires 230/120 V AC, further voltage supplies are possible on request.

System 6842G02

System in a ½ 19" wall housing as stand-alone system. A standard 230/120V AC voltage supply is needed, other voltage supplies are possible on request.

System 6842G03

Stand-alone system built in a ½ 19" table top housing. As a standard it requires 230/120 V AC voltage supply, further voltage supplies are possible on request.

[1] DCF77 = (D) German - (C) long wave signal - (F) Frankfurt - (77) 77,5 kHz

2 Introduction

The **hopf** radio- / crystal clock systems well proved since 1975 have been extended by the GPS[2] receiver unit 6842, thus enabling the world wide use of this time base at highest precision level.

The time base is synchronised by the globally installed satellite-navigation system GPS. At a height of about 20 000 km satellites circle around the earth on different orbits and angles twice a day. On board each satellite there are high-precision atomic-clocks (precision min. 1x 10E-12). GPS reception units receive orbit position and GPS world time from as many satellites as possible. From these values the position of the receiver is calculated. Once the position is identified the delay time of the received GPS world time is calculated. The precision of the time depends above all on the quality of the position identification.

The world time UTC[3] is found by subtracting the leap seconds from the GPS-world time (GPS-UTC); at present (1994) the world time lags 8 seconds behind the GPS-UTC. The difference varies, depending on the insertion of leap seconds. It is possible for any point in the world to enter, by means of the system key pad, the difference to the UTC-time and the regional time changeover points for summer/winter time. Therefore a high precision local time is available for further use.

Various well-tried communication channels like:

- 2 serial RS232 interface
- 2 serial RS422 interface
- 1 kHz frequency output TTL-level
- PPS-pulse TTL-level
- DCF77 simulation of the local or UTC time to control further **hopf** radio controlled clocks
- optional fibre optic interface

are available.

[2] GPS = Global Position System
[3] UTC = Universal Time Co-ordinated

3 Set-up

- connect voltage
- switch on voltage supply
- connect the GPS antenna
- enter local time
- enter time difference
- enter position (not absolutely necessary)
- enter point of changeover **S** ⇨ **D** (not absolutely necessary)
- enter point of changeover **D** ⇨ **S** (not absolutely necessary)
- release program reset
- view time difference
- view position
- view point of changeover **S** ⇨ **D**
- view point of changeover **D** ⇨ **S**
- release master reset

3.1 Voltage Supply

The system is available with different voltage supplies. Therefore please take note of the right voltage and polarity when connecting the power supply.

The standard voltages available are:

for stand alone systems

- 230 V AC +10%, -15%
- 120 V AC +10%, -15%

Other voltage supplies are available on request

> ***PLEASE NOTE :*** *SET-UP BY QUALIFIED PERSONNEL ONLY.*

3.2 Antenna Installation

To guarantee a GPS-reception as constant as possible the antenna must have free "view" of the whole horizon. The dimensional design of the antenna enables it to cover satellites from 10° above the horizon. To decode position and time a "view" to 4 satellites is necessary. If the view of the sky is hidden by buildings the GPS receiver cannot decode the exact time. It waits for 4 satellites to move into "view", which might take up to 4 hours in the case of an unfavourable satellite constellation. The antenna should therefore be installed in the highest roof position (see diagram in the appendix).

3.3 Coaxial Cable Installation

The antenna is connected to the base unit by the included coaxial cable. A coaxial coupling connects cable and antenna in the antenna plate foot. To lay the cable, the coupling may be disconnected by opening the screw at the antenna foot and lifting the foot.

> ***PLEASE NOTE :*** *DO NOT LAY THE CABLE NEXT TO OTHER HF-, CONTROL OR POWER CABLES.*

The leakage from these cables could, because of the extremely low received power, interfere with the GPS reception.

The cable is connected to the base unit at the connector **"GPS in"** of the packaged module. The antenna cable is up to 25m long (with special cable up to 50m). If the cable is longer than 25m (or 50m) up to 150m you need a GPS cable-amplifier.

> ***PLEASE NOTE :*** *THE LAYING OF THE CABLE HAS TO BE CARRIED OUT WITH UTMOST CARE.*

Please ensure that:

- the bend radius of the coaxial cable must never be less than 10cm
- the sheath of the cable must not be damaged in any way
- the cable must not be crimped

3.4 Reception Frequencies

The satellite transmits two frequencies:

L1 at 1,575.42 MHz and L2 at 1,227.6 MHz

L1 can be used for civil purposes. The received power is about -160 dB. The antenna contains a pre-amplifier which boosts the received satellite frequency by +20 dB.

3.5 Set-up Base System

After supplying the correct operating voltage the device or the board is switched on and runs independently. The required settings can be entered by means of the key-pad.

3.5.1 Display

In case of the first set-up or after 3 days without voltage supply the following picture is displayed on the 2 x 16 digit LCD display:

LOC.-T: [1] **00:00:00**
[2] **S - C** [3] **- -** [4] **- - / - - - / - - - -**

The positions have the following meaning:

[1] **LOC.-T:** **00:00:00**
Here the local time is displayed.

[2] status display: If the standard output is the UTC-display, **UTC:** appears instead of **LOC.-T:,**

position 1 **X--** **"S"** for **s**tandard time
"D" for summer time (**d**aylight time)

position 2 **-X-** **"A"** announcement of changeover to a different time zone. The announcement occurs one hour before the time zone changeover.

position 3 **--X** Display of the internal status of the clock system:
"C" = the clock system runs on crystal operation.
"r" = the clock system is running GPS synchronously but without seconds and crystal adjustment control
"R" = the clock system runs on GPS reception at highest accuracy and output of the PPS-pulse (R = radio).

[3] Display of the days of the week abbreviated:
MO - TU - WE - TH - FR - SA - SU

[4] Display of the date:
day / short form of month / year

The lighting of the display is switched on as soon as the voltage supply is connected or a key is pressed. If the key- pad is not used for any entries for 4 minutes the lighting switches itself off again. Thus ensuring a longer life of the display.

3.5.2 Standard Display

After a power cut (< 3 days), the display starts with the internally continued back-up clock information.

4 Key-Pad

4.1 Key Functions

+/- = entry of sign of numbers
BS = BACKSPACE, deletes the last entry
BR = BREAK, stops all key controls
ENT = ENTER, activates the key pad and takes over entered values

4.1.1 Key-Pad Entry / System Control

The main menu is activated by pressing **"ENT"**.

The display changes from showing the time information to displaying the main menu, where at present 4 entry or control modes can be selected. The mode wanted is found by entering the according digit.

Start-picture:

SET = 1 SHOW = 2
S.CLOCK = 3 INI = 4

The modes have the following meaning:

SET: input of set functions like time/date, position, time offset etc.
SHOW: selection of display functions like time difference, position etc.
S.CLOCK: input of set functions like start, stop and pulse of synchronous clock
INI: initialising functions - these functions are required mainly by the production. They serve to set supervision times and pulse widths.

4.2 SET-Functions

When the number 1 is entered the program returns to the set-functions. The program is structured as a user guidance. All the sub-functions are shown on display and selected by

"Y" = yes or turned down by

"N" = no

any key but **"Y"** and **"BR"** is read as no.

When **"N"** is selected the next sub-function is displayed. At present the following set functions can be chosen.

4.2.1 Time/Date Entry

selection picture

SET TIME Y / N _

entry picture

TIME: **HH:mm:ss**
d.DD/MM/YY.Z

This entry function can set the local time. The entry has two lines and must be complete. Leading naughts must also be entered.

The positions have the following meaning:

Input	1. step	**HH**	=	hour	range	from 00 - 23
	2. step	**mm**	=	minute	"	from 00 - 59
	3. step	**ss**	=	seconds	"	from 00 - 59
	4. step	**d**	=	day of the week	"	from 1-7
				1 for Monday...7 for Sunday		
	5. step	**DD**	=	day	range	from 01 - 31
	6. step	**MM**	=	month	"	from 01 - 12
	7. step	**YYYY**	=	year	"	from 1990 - 2089

All entries are taken over by pressing the **"ENT"** key.

If the entry is plausible, the time is taken over into the system, otherwise the information **"INPUT-ERROR"** is shown for 3 seconds. The set-function is left at **"INPUT-ERROR"**, the standard picture is displayed again. To continue the entry any key but **"Y"** and **"BR"** may be pressed.

BReak leaves the set program. The standard picture reappears.

PLEASE NOTE : *IN COUNTRIES WHICH CHANGE THEIR TIME-ZONE DURING THE COURSE OF THE YEAR THE CHANGEOVER TIMES MUST BE ENTERED. (SEE 4.2.3)*

4.2.2 Time Difference

selection picture

SET DIF.-TIME Y/N _

entry picture

DIF-TIME: _

By means of this function the time difference between the local standard time and the world time (UTC time) is entered. The sign indicates in which direction the local standard time deviates from the world time.

Generally:

+ means east
– means west of the 0 meridian.

As most countries in the world chose their time difference in full hours, the entry is made in hour steps.

e.g. **+ 05:00**; **- 11:00**

Some countries though have shorter time steps. Here minutes can be entered.

e.g. **+ 05:30**; **- 8:45**

> ***PLEASE NOTE :*** *THE TIME DIFFERENCE ALWAYS REFERS TO THE **LOCAL STANDARD TIME**, EVEN IF THE SET-UP OR ENTRY OF THE TIME DIFFERENCE OCCURS DURING THE SUMMER TIME.*

4.2.3 Time Zone Changeover

Some countries in the world, depending on the season, have two time zones - a standard time (also called winter time) and a summer time. The summer time has a time offset of +1 hour compared to the standard time. The exact change over date for the current year is calculated by means of the entered parameters. The parameters allow a change over to any point of time. The user is informed by the **show**-function where the exact date is stated. If the country has no time zone changeover, naughts are entered in all positions.

selection picture

for daylight saving/standard time changeover

SET CHANGE-OVER
DATE D→ S Y/N

(**D**aylight saving time ⇨ **S**tandard time)

for the standard/daylight saving time change over

SET CHANGE-OVER
DATE D→ S Y/N

(**S**tandard time ⇨ **D**aylight saving time)

entry picture

D → S hh/d/w/MM
>

S → D hh/d/w/MM
>

The entries have the following meaning

hh = the hour when the changeover is due
00 ... 23 h

d = the day of the week when the changeover is due
1 = Monday ... 7 = Sunday

w = the number of the day of the month when the changeover is due
1 ... 4 day of the week e.g. 1 ... 4 th Sunday in the month
5 last day of the week e.g. last Sunday in the month

MM = the month when the changeover is due

The entry is completed by ENT.

4.2.4 Position

selection picture

SET Position
Y/N _

By means of this function the geographic position of the unit is entered. This function helps at first set-up, because it shortens the initialising of the GPS receiver, but it is not essential.

entry picture

LT._

Longitude and latitudes are entered with degrees and minutes starting with the sign for the latitude:

N = northern hemisphere
S = southern hemisphere

then degrees and minutes are entered, (two digits each), and 4 digits after the minutes.

entry picture

LT.N51°12,3651
LT._

The longitude entry starts with:

E = east of the 0 meridian
W = west of the 0 meridian,

then follows the entry for degrees - three digits - and after the separation point the minute entry follows (- two digits -) plus 4 digits after the minutes.

e.g. **N51°12.3651**
E007°37.8426

When **"ENT"** is pressed all entries are taken over.

For a faster synchronisation the GPS receiver only needs the entry of the approximate position. For the precise position in the above example the following entry would suffice:

N50°00.0000
E006°00.0000

4.2.5 Status and Pulse Output

There is a programmable output available at the connector strip (pin 8c) which can be assigned with status or pulse messages.

The programming is done by entering a byte. The programming is requested by the following picture:

SET STATUS- OR
PULS-OUTPUT Y/N

Entering (**Y**)es the entry picture appears

BIT 7654 3210

Only a "0" or a "1" can be set for the individual bits in the second line."1" is to be regarded as switch-on function. As there is only one output available only one "1" may be set in the byte. In case of several "1" statuses the function for the lowest bit is implemented.

The bits have the following meaning for the switching of the output to GND.

Bit 7	free	
Bit 6	free	
Bit 5	free	
Bit 4	daily pulse (24 o'clock)	on-period 1 s
Bit 3	hourly pulse	on-period 1 s
Bit 2	minute pulse	on-period 1 s
Bit 1	second marker	on-period 250 msec
Bit 0	status radio operation	

4.2.6 Systembyte

The individual bits in the systembyte can be used to switch on/off functions. At present no bit is in use.

4.2.7 Serial-Interface-Parameter

For each of the two interfaces the parameters like baud rate, parity etc. and the modes can be entered separately. The following selection pictures appear.

4.2.8 Selection Picture Parameter of Serial Interface

SET COM 0 SERIAL	**or**	**SET COM 1 SERIAL**	**or**	**SET OPTICAL TRNS**
PARAMETER Y/N _		**PARAMETER Y/N _**		**PARAMETER Y/N _**

see point 6: Parametering of the serial interfaces.

4.2.9 Setting Modebyte 1 Selection

selection picture

SET COM 0	**or**	**SET COM 1**	**or**	**SET OPTICAL TRNS**
MODE_1 Y/N _		**MODE_1 Y/N _**		**MODE_1 Y/N _**

see point 7: Structure of data string of the serial interface with modebyte 1

4.2.10 Setting Modebyte 2 Selection

selection picture

SET COM 0	**or**	**SET COM 1**	**or**	**SET OPTICAL TRNS**
MODE_2 Y/N _		**MODE_2 Y/N _**		**MODE_1 Y/N _**

see point 7 : Structure of data string of the serial interface with modebyte 2

4.2.11 Selecting Display and DCF77-Simulation

For the display and the DCF77-simulation either local or UTC time can be selected.

selection picture

SET TIME-OUTPUTS
DISPLAY/DCF Y/N _

entry picture

LOC.-T = 0 UTC = 1
DISPLAY / DCF:

This can only be changed as a whole, the following combinations are possible:

display	DCF77-simulation	
LOC.-TIME	LOC.-TIME	0 / 0
LOC.-TIME	UTC.-TIME	0 / 1
UTC.-TIME	LOC.-TIME	1 / 0
UTC.-TIME	UTC.-TIME	1 / 1

4.2.12 LAN-IP-Addresses (Optional)

When the system is extended by one or two LAN-boards the LAN-IP address and another control bit can be entered via the key-pad.

For further information please see description LAN-board 7270

4.2.13 Frequency Input (Optional)

If a frequency output board is added to the system this function can be used to enter the frequency between 1 Hz to 10 MHz in steps of 1 Hz. The input mode is described in the description for the board 7530.

4.2.14 Key-Word

The entry via key-pad can be protected from unauthorised access by a 4-digit key-word. There is no key-word entered by our company. The customer must set it himself in the **"SET"**-menu.

selection picture

SET KEY-WORD
Y/N

After entering (**Y**)es the display shows the entry picture.

entry picture

KEY-WORD >_

Now a 4-digit number can be entered as key-word except for the sequence

KEY-WORD >0 0 0 0

because this sequence **deletes** the set key-word.

> ***PLEASE NOTE :*** *PLEASE KEEP THE KEY-WORD IN A SAFE BUT KNOWN PLACE.*

In case the key-word is lost the circuit board must be returned to our company to be re-programmed.

The key-word is active the next time you turn to the menu.

When a menu item is selected you will be asked for the key-word.

KEY-WORD >_

Every entry of a digit is indicated by a * and an arrow completes the entry after the fourth digit.

KEY-WORD >* * * *<

"ENT" confirms the key-word. If the key-word is correct the according menu item is displayed.

In case of a false entry the following is displayed for 5 seconds

WRONG KEY-WORD

After the 2nd false entry the following is displayed for 5 seconds

WRONG KEY-WORD
! LAST CHANCE !

After the 3rd false entry the following is displayed for 5 seconds

WRONG KEY-WORD

and when trying to restart the menu

KEY-PAD
SWITCHED OFF

is displayed.

The entry is blocked for 4 hours. Even rebooting the system does not affect the blocking period.

The system is still fully functional. After 4 minutes the display returns automatically or by pressing the **(BR)** key to the display of the time.

4.2.15 Data Security

All the entry data of points 4.2.2 - 4.2.13 are checked for plausibility and then stored in a voltage fail-safe EEPROM after the next minute change. To check the values a **program reset** or a **master reset** must be executed so that the stored values in the EEPROM are reread into the main memory.

4.3 Checking the Entered Values

To check the entered values or those updated by the GPS receiver, the **SHOW**-function is called up.

After jumping to the display of the main menu by pressing **"ENT"** the number **2** is entered. The first **SHOW** selection picture appears.

The **SHOW**-function can be interrupted by **"BR"** = break at any time.

4.3.1 Time Difference

This functions allows to view the actual time difference between the local time and UTC time.

selection picture

SHOW DIF.-TIME
Y/N _

After pressing **"Y"** the time difference is displayed e.g. as follows:

DIF.-TIME: +02:00 _

If **"N"** or any other key except **"Y"** and **"BR"** is entered the display jumps to the next selection picture.

4.3.2 Time Zone Changeover S ⇨ D

This function shows the point of changeover from standard time (winter time) to daylight time (summer time).

selection picture

SHOW CHANGE-OVER
S ⇨ D Y/N _

After pressing the **Y**es key the following is displayed.:

TIME: 02.00.00
7.29/03/1998 S>D

The changeover will be (was) on Sunday 29. March 1998 at 02.00 o'clock

4.3.3 Time Zone Changeover D ⇨ S

This function shows the point of changeover from daylight time (summer time) to standard time (winter time).

selection picture

SHOW CHANGE-OVER
D ⇨ S Y/N _

After pressing the **Y**es key the following is displayed:

TIME: 03.00.00
7.25/10/1998 D>S

The changeover will take place on Sunday 25th October 1998 at 03.00 o'clock .

4.3.4 Position

By means of this function the entered or the GPS updated position is displayed. 4 decimal points of the position minutes are displayed. GPS updates the position every second.

selection picture

SHOW POSITION
Y/N _

display

e.g. **LT. N51°12.6878'**
LN. E007°39.8032' (position of **hopf** company in Lüdenscheid)

LT = latitude, **LN** = longitude

4.3.5 Status and Pulse Output

This function serves to show the programming byte for the output at Pin 8c of the VG strip.

request picture

SHOW STATUS- AND
PULS-OUTPUT Y/N

After entering (**Y**)es the following is displayed:

Bit 7 6 5 4 3 2 1 0
0 0 0 0 0 1 0 0

This means that at output 8c a minute pulse is programmed.

4.3.6 Satellite Display

To synchronise the device with UTC, 4 satellites within the view range of the antenna are necessary. At best 9-10 satellites are within the view range of the antenna, out of which 6 can be received parallel.

By means of the menu choice

SHOW SATELLITES
Y/N _

the number of satellites within view, the number of received satellites and the relative measure for the reception power are displayed.

This function is particularly helpful during the installation of the device. After the menu item has been selected the following picture appears on display

V : :
: :

Under **(V)**isible the number of satellites visible for the ideal antenna position on this location is shown. This is a theoretical value.

Six satellites can be received but only four satellites can be shown in the display. Therefore the display switches over every five seconds.

The number before the colon is the satellite-pseudo-random-number. The satellites are not numbered 1, 2, 3 etc. but they have a pseudo random number under which the satellites broadcast their information. In case of a satellite failure a spare satellite can be activated under the same number.

The number after the colon stands for the signal-noise-ratio as relative figure. This can range between 0-255.

After the first installation it can take up to 1 hour before anything is written in the picture, depending on the start information the system receives (see programming time, position) and on the antenna position e.g. only half the sky within view.

If there are values in the system the display can look as follows:

V 05:137 17:043
07 : :

7 satellites are in the theoretically visible range. The GPS receiver receives satellite 05 at a signal/noise ratio of 137 and satellite 17 at a signal/noise ratio of 43.

This number does not suffice for a synchronisation with UTC.

In case of a bad signal/noise ratio the value ranges between	**10 - 30**
In case of a sufficient signal/noise ratio the values range between	**30 - 70**
In case of a good signal/noise ratio the values range between	**> 70**

PLEASE NOTE : *TO AVOID ERRORS IN THE MENU SELECTION, LEAVE THIS FUNCTION ONLY BY THE* ***"BR"*** *KEY.*

4.3.7 Error Interpretation

Errors in the reception system can be recognised by means of the display picture of the satellites.

Example 1

No satellite appears in the display even after several hours after the first installation.

Possible faults:

- the antenna cable has a defect
- the antenna cable is not connected
- the antenna has a defect
- the lightning protection has a defect

Example 2

There are 7 satellites in the view range, but only up to 2 appear on the display.

Fault

- the visible range of the antenna is too small.

Example 3

9 satellites appear within the view range, 6 are received but the system does not synchronise because the signal/noise ratios all range between 10-25.

Possible faults:

- the cable is too long
- the BNC-connectors are badly assembled
- the cable is crimped or bent
- the cable have the wrong impedance

Example 4

The system has run perfectly so far. 7 satellites appear in the view range, none are tracked, the system has been running without reception for several days.

Possible faults:

- the cable has been damaged
- a flash of lightning has occurred and the lightning protection has a defect
- the antenna has a defect
- the receiver has a defect
- the voltage supply has a defect

4.3.8 Error Byte

To speed up the error analysis faulty functions or chips are shown in a bit in this error byte. A logic "0" means that the function or chip is o.k.. A logic "1" indicates that there is a fault.

At present the following bits in the error byte are in use:

Bit 7 = free
Bit 6 = free
Bit 5 = free
Bit 4 = free
Bit 3 = free
Bit 2 = free
Bit 1 = error in the GPS week-counter
Bit 0 = error in the calculation of the difference between local time and UTC

4.3.9 Further SHOW-Functions

There are further SHOW-functions e.g.

SHOW COM_1 SERIAL
PARAMETER Y/N **etc.**

This is self-explanatory.

4.4 Initialising Functions

These ini-functions can be used to call up different tests during the set-up or to check internal functions. These functions are pre-set by the company.

The following entry sequence puts you into the initialising program. Pressing the key **"ENT"** shows the menu selection picture (see Pt. 4.1.1). Entering the digit **"4"** activates the functions of the initialising programs.

Entering break **"BR"** returns you to the standard display.

Several functions are available for the customer.

4.4.1 Delay of the Status Change

The display also shows in the serial data strings whether the system is synchronised by GPS or whether it is running on internal crystal basis. In connected devices this information is often used for error messages. To avoid a short interruption of the reception being interpreted as an error, the status change from reception to crystal basis can be delayed. The delay period can be set from 2-255 minutes.

Both viewing and changing the time is carried out in the same display picture by means of the following call-up.

TIME-OUT FOR STA-
TUS-CHANGE Y/N

Entering **"Y"** calls up the display picture:

STATUS CHANGE
AFTER > xxx < MIN

The xxx are replaced by the presently valid delay period.

The key **"+"** increases the time and **"–"** diminishes it.

When you leave the programme by means of the key **"BR"** the value displayed last is stored in a non-volatile memory.

4.4.2 Delaying the Time Out of the DCF77-Simulation

The start of the DCF77 antenna signal requires at least one previous synchronisation of the system with GPS, which guarantees the according accuracy of the signal. After that the DCF77-simulation continues running even after a GPS-synchronisation failure.

An error might not be detected by a connected device. Therefore the DCF77-signal is put out disturbed after a GPS-synchronisation failure. To avoid every short GPS-receiving disturbance to cause an immediate DCF77-signal disturbance, it is possible to delay the beginning of the disturbance.

The delay time can be set from 2 - 254 minutes. In case of 255 minutes a simulation is always carried out. Therefore a DCF77-simulation can be made for any other time entered via the key-pad. Usually this setting is used to test time depending functions in the connected devices. Please make sure that the antenna has been removed for this case, because the synchronisation via the antenna overwrites the time entered manually.

Both viewing and altering the time is carried out in the same display screen by means of the following call-up:

TIME-OUT FOR DCF-
SIMULATION Y/N

Entering "**Y**" calls up the display screen.

DCF-SIM STOP
AFTER > xxx < MIN

The presently valid delay time replaces the >xxx<.

The key "**+**" increases the time and "**–**" diminishes it.

When you leave the programme by means of the key "**BR**" the last displayed value is stored in a non-volatile memory.

4.4.3 DCF77-Pulse Width

In the DCF77 time data string the time information is transmitted in the BCD format. A logic 1 equals the pulse duration of 200 msec and a logic 0 equals 100 msec. Some manufacturers do not comply to this rule and give out shorter pulses e.g. 160 msec. for logic 1 and 70 msec. for logic 0. The pulse width can be altered so that these devices can be synchronised.

The display picture, used both for viewing as well as altering, is called up by the following command:

SET DCF
HIGH-PULS Y/N

Entering "**Y**" shows the following picture:

DCF HIGH-PULS
>xxx< MSEC

xxx are replaced by the pulse duration valid at present.

By means of the key "**+**" the pulse is increased and by "**–**" it is diminished.

When the program is left by the key Break "**BR**" the value displayed last is stored in a non-volatile memory.

The call-up to set the low-pulse follows the same pattern.

The high-pulse can vary between 150-250 msec. and the low-pulse can vary between 50-150 msec.

4.4.4 Time Decoding 3D / Position fix

The accuracy of the time decoding depends on how accurately the position of the operational location is calculated. At least 4 satellites are required (3D decoding). From the calculated position the transit time of the signal to several satellites is found and the second marker is produced from the average transit times. The 3D decoding mode allows the second marker to have an accuracy of ± 1 µsec.

In case of a fixed position quite often a less substantial decoding of the second marker suffices e.g. up to some milliseconds. In the position-fix mode the accuracy depends mainly on the precise entry of the position of the location of the installation. The calculation of the second marker already starts with one satellite and the entered position. An entry of the position to ± 1 minute degree achieves an accuracy of the second marker better than ± 20 µsec. An even more precise entry can achieve a value of ± 1 µsec.

The position-fix mode has the advantage that the clock synchronises with only one satellite. The antenna may be installed somewhere where less than ¼ of the sky is visible.

Often it is possible to install the antenna indoors at the window (short cable, no lightning protection). If 4 satellites are visible in this mode, the decoding jumps automatically into the 3D mode and calculates the exact position improving the accuracy to ± 1 µsec. for one satellite.

The following entry sequence set the modes

selection picture

SET POS. FIX / 3-D
ACCURACY Y/N

Entering "**Y**" shows the currently set mode

For position-fix decoding it is:

ACT. IS POS.FIX
FOR 3-D PUSH +

The accuracy can be changed to 3D by entering +.

The 3D decoding displays:

ACT. IS 3-D FOR
POS.FIX PUSH -

The variable accuracy can be changed to position fix by entering - (minus).

4.4.5 Program-Reset

With this function the program counter will be set back to the beginning. After jumping into the menu-picture by pressing "**ENT**" the Ini-range of functions is activated by digit 4. The first picture for the Ini-functions appears. After pressing any key except "**Y**" or "**BR**" several times the following option frame appears.

PROGRAMM RESET

Y/N _

After pressing "**Y**" the program-reset will be executed. The program jumps back to the beginning of the program. Other functions are not carried out.

4.4.6 Master Reset

The selection is done through the following picture:

MASTER RESET

Y/N _

After pressing "**Y**" the master-reset will be executed. The reset-connection of the board will be set to zero for a short time. Thereby all other modules in the system are set to zero and the program jumps back to the beginning of the program.

4.5 Summary Key Pad

- the menu is activated by pressing the **ENT** key.
- selection of functions by **1** to **4**
- switch to standard picture by **BR**eak
- end of entries by **ENT**er
- selection of individual functions by **Y**es
- pass function by No or any other key except **BR**eak and **Y**es.
- plausibility errors are indicated by **INPUT-ERROR**, new selection and entry is required.

4.5.1 Set Functions

valence

C	thousand	**T**	tens
D	hundred	**S**	unit
N	post decimal digit		

- local time

HOUR	T	H	0 - 2
HOUR	S	H	0 - 9
.			
MINUTE	T	m	0 - 5
MINUTE	S	m	0 - 9
.			
SECOND	T	s	0 - 5
SECOND	S	s	0 - 9
.			
.			
day of the week		d	1 - 7
.			
DAY	T	D	0 - 3
DAY	S	D	0 - 9
.			
MONTH	T	M	0 - 1
MONTH	S	M	0 - 9
.			
.			
YEAR	C	Y	1 - 2
YEAR	D	Y	0 - 9
YEAR	T	Y	0 - 9
YEAR	S	Y	0 - 9
.			

- TIME-OFFSET

sign ±	+ or -
tens digit hour	0 - 1
unit digit hour	0 - 9
.	
tens digit minute	0-5
unit digit minute	0-9

point of time zone changeover
data string as local time

- position

latitude

sign	P	N or S	
degree	T	G	0 - 8
degree	S	C	0 - 9
.			
minute	T	M	0 - 5
minute	S	M	0 - 9
.			
post decimal pos.	N		0-9
post decimal pos.	N		0-9
post decimal pos.	N		0-9
post decimal pos.	N		0-9

longitude

sign	P	E or W	
degree	H	G	0 - 1
degree	T	G	0 - 9
degree	S	C	0 - 9
.			
minute	T	M	0 - 5
minute	S	M	0 - 9
.			
post decimal pos.	N		0-9
post decimal pos.	N		0-9
post decimal pos.	N		0-9
post decimal pos.	N		0-9

4.6 Display Functions

- time-offset
- standard / daylight change-over
- daylight / standard change-over
- position
- satellite
- interface parameter
- interface mode byte
- LAN-IP address and control byte
- control of frequency board
- control of display
- pulse and status output
- systembyte
- error byte

4.7 Control of Synchronous Clocks

If the circuit board 6842 is used in a sub-system with synchronous clock lines, these lines are controlled via menu pt. 3.

Up to 4 lines can be managed by the board (see description board 7406).

After menu pt.3 is called up, the selection picture for the number of the synchronous clock appears.

SLAVE CLOCK NO.
1 - 4 >

Entering number 1-4 selects the according synchronous clock line. This number is kept in all subsequent pictures.

To control the synchronous clock line the following points are available.

4.7.1 Viewing Synchronous Clock

This command shows all information about the synchronous clock.

selection picture

SLAVE CLOCK NO: x
SHOW Y/N

x = number of synchronous clock line

When "**Y**" is entered the status picture of the synchronous clocks is shown.

e.g.

SC.x R: 15.43.17
3,0 s 19/01/98

or

SC.x S: 15.45.18
3,0 s 19/01/98

x =	stands for the selected synchronous clock line	
R =	**R**un	the synchronous clock is running
S =	**S**top	the synchronous clock has stopped
		15.43.17 and 15.45.18 is the time of the synchronous clock
		15.43.18 19/01/98 date of the synchronous clock day/month/year

The display will be actualised every 5 seconds.

When pressing "**BR**" the display will be stopped and pressing "**ENT**" allows the change into the next menu.

4.7.2 Setting the Synchronous Clock

After commissioning or after repair works to the synchronous clock line the clocks must be updated to the current time.

selection picture

SLAVE CLOCK NO.x
SET Y/N

The entry picture appears once "**Y**" is entered.

SC.-NO. x SET TIME
>

The time shown by the **synchronous clocks** is now entered in **HR : MI : SE**, ended by **ENT.** The date is added automatically. The complete data string is now transmitted to the according synchronous clock. If this clock was stopped before this entry automatically starts the clock again. A master reset of the system also releases an automatic start of the clocks.

Please note the following: If synchronous clocks with 12 or 24 hour clocks are used together the time of the 24 hour clock must be entered.

4.7.3 Start/Stop Synchronous Clock

In case of commissioning or repairing the synchronous clock we advise stopping the clock line first.

All the clocks must be set mechanically to the same time in case of commissioning. Then following pt.5.2 puts the clock into operation.

The repair of a synchronous clock e.g. exchange of a clock, requires the mechanical setting of the exchanged clock to the time of the other clocks to put the line back into operation.

selection picture

SLAVE CLOCK NO.x
RUN /STOP Y/N

Entering "**Y**" shows the selection picture

SLAVE CLOCK NO.x
RUN = + STOP = --

+ = Start of the line
– = stopping the line

Completing the entry by ENT not necessary

4.7.4 Synchronous Lines Pulse Time

The analogue synchronous clocks need a pole-alternating setting pulse varying in length depending on the size. This pulse can be set individually for every line between 0.1 s and 3.1 s. The pulse break corresponds with the pulse duration so that a pulse cycle is twice as long as the adjusted pulse duration.

Selection picture

SLAVE CLOCK NO.x
SET PULS Y/N

The following entry picture appears once **"Y"** is entered

S.CLOCK x PULS
IN=+/- > 3,0 < sec

At present the valid pulse is up to 3.1 seconds long. It can be increased by + or diminished by - in steps of 0.1 sec.

The pulses are stored in a fail-safe memory. Completing the entry by **ENT** is not required.

When pressing "**BR**" the display will be stopped and pressing "**ENT**" allows the change into the next menu.

5 Configuration

5.1 Configuration of the Serial Interfaces

The clock is equipped with two serial interfaces with handshake lines, which can be set independently. Data can be exchanged via the RS232c (V.24) and RS422 (V.11) signal level. These interfaces can be used for the transmission of time data strings to other computers.

There is also an optical serial interface without handshake with plastic or optical fibre lines available for transmission.

Various data strings are available. Customised data strings are available on request. The following settings can be done individually for every serial interface.

5.2 Parameter of the Serial Transmission

The interface is parametered by means of the key pad. The setting for baud rate, data bit, stop bit and parity is reached by pressing the **[ENT]** key and selecting the **"SET"** function. In the selection dialogue the entry for **COM0**, **COM1** or **optical interface** must be chosen. Only the interface **0** is described below. The same settings apply to the interface **1** and for the optical interface.

- **[ENT]** - key
- **"1"** for "SET - functions"
- select "SET COM0 SERIAL PARAMETER Y/N"
- **"Y"**

The interface - parameter - dialogue appears on LCD-display showing:

B:_

Here the baud rate must be entered as a five digit numeric value. The following entries are possible:

- 19200 for 19.200 baud
- 09600 for 9.600 baud
- 04800 for 4.800 baud
- 02400 for 2.400 baud
- 01200 for 1.200 baud
- 00600 for 600 baud
- 00300 for 300 baud
- 00150 for 150 baud

After the entry of the last digit the following message is displayed:

W:_

Here the number of data bit for the transmission must be entered. Possible entries are:

- 8 for 8 data bit
- 7 for 7 data bit

After the entry of the digit for the number of data bits the following message is displayed:

P:_

Here the type of parity bit for the transmission must be entered. Possible entries are:

- N for no parity
- E for parity even
- 0 for parity odd

The following message is displayed:

S:_

Here the number of stop bits for the transmission must be chosen:

- 1 for 1 stop bit
- 2 for 2 stop bit

Finally the release for the handshake lines RTS and CTS appears:

HS:_

The following can be entered here

- N data transmission **without** handshake
- Y data transmission **with** handshake

After the entry of the number of stop bits the key **[ENT]** must be pressed, which causes a plausibility check of all entries. If all the entries are plausible the settings are taken over.

PLEASE NOTE : *IN CASE OF A FAULTY ENTRY YOU CAN USE THE KEY* ***[BS]*** *(BACKSPACE) TO RETURN TO THE PREVIOUS EDITING FIELD AND REWRITE IT.*

5.3 Configuration of the Data String (Modebyte)

The time information received via satellite can be put out via the interface in a data string stating the internal clock status. This enables the user to synchronise connected computers with the atom accurate time. The read out point of time, the string structure and the used control characters can be chosen by entering the according **modebyte 1 and 2**.

You reach the set function for the **modebyte** via the following keys:

- **[ENT]** key
- **"1"** for "SET functions"
- selection of "SET COM0
  MODE 1 / 2 Y/N"
- **"Y"**

The input mask for the **modebyte** appears:

BIT 7654 3210

The LCD cursor is now under the bit position 7. Every bit is like a switch by means of which the mode of the serial interface can be set. Depending on the required mode of the serial interface either

0 = switch off
or 1 = switch on

must be entered under every bit position. The meaning of every bit position (switch) is explained in the chapters below.

5.3.1 Local Time or UTC in the Serial Output with Mode Byte 1

bit position 7	time zone
on	local time
off	UTC (Universal Time Co-ordinated)

5.3.2 Second Advance of Serial Output with Mode Byte 1

bit position 6	second advance
off	with second advance
on	without second advance

5.3.3 Bit 5

bit position 5	
off	free
on	free

5.3.4 Last Control Character as On-Time-Mark with Modebyte 1

In this setting the last control characters (see string structure) can be transmitted on the marker of the next second change.

bit position 4	control character on the second change
off	with control character on second change
on	without control character on second change

5.3.5 Control Character CR and LF with Modebyte 1

This switch is used to exchange the characters CR and LF.

bit position 3	control characters CR and LF
off	LF / CR
on	CR / LF

5.3.6 Delayed Transmission

In the setting "control characters on the second change" the last character of the data string is transmitted on the second change and straight afterwards the string which is valid for the new second change. This may cause error messages in computers under heavy load. Bit position 2 can be used to delay the transmission of the data string depending on the baudrate.

Example:

Baudrate 9600 Baud

Milliseconds	delayed	not delayed
000	final character (ETX)	final character (ETX)
002	–	new data string
025	–	end of new data string
930	new data string	-
955	end of new data string	–
000	final character (ETX)	final character (ETX)

Baudrate 2400 Baud

Milliseconds	delayed	not delayed
000	final character (ETX)	final character (ETX)
002	–	new data string
105	–	end of new data string
810	new data string	-
913	end of new data string	–
000	final character (ETX)	final character (ETX)

bit position 2	delayed transmission
off	with delay
on	without delay

5.3.7 Synchronisation Point with Modebyte 1

Bit 1	Bit 0	point of transmission
off	off	transmission every second
off	on	transmission on the minute change
on	off	transmission on the hour change
on	on	transmission on request only

5.3.8 Selection of Data String with Modebyte 2

This modebyte serves to set the putout data string. At present only bit position 0-3 are in function, the other bits are reserved for later extensions.

Bit position				structure of data string
3	2	1	0	
off	off	off	off	Standard ***hopf*** data string
off	off	off	on	Standard ***hopf*** with year in 4 digits
off	off	on	off	DCF-Master/Slave data string
off	off	on	on	Siemens SINEC H1
off	on	off	off	T-String
off	on	off	on	IBM Sysplex-Timer 1 + 2

5.4 Data Format of the Serial Transmission

The data are transmitted as BCD values in ASCII and can be displayed by every terminal programme (e.g. TERMINAL.EXE under Windows). The following control characters from the ASCII set of characters are used in the data string if necessary.

- $20 = space
- $0D = CR (carriage return)
- $0A = LF (line feed)
- $02 = STX (start of text)
- $03 = ETX (end of text)

> ***PLEASE NOTE:*** *THE STATUS VALUES MUST BE DECODED SEPARATELY (SEE DATA STRING STRUCTURE).*

5.5 Serial Request

The requests of data strings which are not listed in this chapter are described with the data strings.

5.5.1 Serial Requests with ASCII Characters (Standard and Standard 2000)

The user can start a data string output using a control character. These control characters are:

- ASCII **"D"** -- for time/date (local time)
- ASCII **"G"** -- for UTC time/date

The system answers within 1 msec. with the according data string.

This is often too fast for the requesting computer. It is therefore possible to delay the answer in 10 msec. steps by software in case of request. To delay the transmission of the data string the small letters "d,g" are transmitted to the clock by the requesting computer with a two digit multiplication factor.

The multiplication factor is interpreted by the clock as hexadecimal values.

Example:

The computer sends **ASCII gFF** (Hex 67, 46, 46)
The clock sends the data string UTC time/date after approx. 2550 milliseconds.

6 Data Strings

6.1 General Information about the Serial Data Output of the Board 6842

In case of the setting ETX on the second change there may be a gap in the transmission of up to 970 msec. depending on the baud rate. Please take this fact into consideration when programming a time-out on the reception side.

In all the data strings it is possible to exchange the control characters CR and LF by means of **mode byte 1**.

The transmitted data strings are compatible with the data strings of the following **hopf** radio controlled clocks.

- board 6020/6021 standard with control characters
- board 7200/7201 standard with control characters
- board 7220/7221 standard with control characters
- board 7240/7245 standard with control characters
- board 6840/6841 standard with control characters
- system 4465 standard with control characters
- system 6870 standard with control characters

6.2 Structure of the Hopf Standard Data String

character no.	meaning	
1	STX (start of text)	
2	status (internal clock status)	; see 6.2.1
3	day of the week (1=Monday...7=Sunday) for UTC time bit 3 is set to 1 in the day of the week	; see 6.2.1
4	hour tens digit	
5	hour unit digit	
6	minute tens digit	
7	minute unit digit	
8	second tens digit	
9	second unit digit	
10	day tens digit	
11	day unit digit	
12	month tens digit	
13	month unit digit	
14	year tens digit	
15	year unit digit	
16	LF (line feed)	; see 6.1
17	CR (carriage return)	; see 6.1
18	ETX (end of text)	

6.2.1 Status and Day of the Week Nibble in the Hopf Standard Data String

The second and the third ASCII-characters contain the status and the day of the week. The status is decoded binaurally. The structure of these characters:

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	no announcement hour
	x	x	x	1	announcement hour (ST-WT-ST)
	x	x	0	x	winter time (WT)
	x	x	1	x	daylight saving time (ST)
	0	0	x	x	time/date invalid
	0	1	x	x	crystal operation
	1	0	x	x	radio operation (basic operation)
	1	1	x	x	radio operation (high accuracy)
day of the week nibble:	0	x	x	x	CEST/CET
	1	x	x	x	UTC - time
	x	0	0	1	Monday
	x	0	1	0	Tuesday
	x	0	1	1	Wednesday
	x	1	0	0	Thursday
	x	1	0	1	Friday
	x	1	1	0	Saturday
	x	1	1	1	Sunday

6.2.2 Example of a Transmitted Hopf Standard Data String

(STX)E3123456170496 (LF)(CR)(ETX)

radio operation (high accuracy)
daylight saving time
no announcement
it is Wednesday 17.04.96 - 12:34:56h
( ) - ASCII control characters e.g. (STX)

6.3 Data String SINEC H1

The control characters STX and ETX are transmitted only if the output is set "with control characters". Otherwise there are no control characters. In case of the setting "ETX delayed" the last character (ETX) is transmitted exactly on the next second change.

The data string can be requested by "**?**" and "**T**".

character no.	meaning	value (value range)	
1	STX (start of text)	$02	
2	"D" ASCII D	$44	
3	":" colon	$3A	
4	tens day	$30-33	
5	unit day	$30-39	
6	"." point	$2E	
7	tens month	$30-31	
8	unit month	$30-39	
9	"." point	$2E	
10	tens year	$30-39	
11	unit year	$30-39	
12	";" semicolon	$3B	
13	"T" ASCII T	$54	
14	":" colon	$3A	
15	day of the week	$31-37	
16	";" semicolon	$3B	
17	"U" ASCII U	$55	
18	":" colon	$3A	
19	tens hours	$30-32	
20	unit hours	$30-39	
21	"." point	$2E	
22	tens minute	$30-35	
23	unit minute	$30-39	
24	"." point	$2E	
25	tens seconds	$30-36	
26	unit seconds	$30-39	
27	";" semicolon	$3B	
28	"#" or space	$23 / $20	;see 6.3.1
29	"*" or space	$2A / $20	;see 6.3.1
30	"S" or space	$53 / $20	;see 6.3.1
31	"!" or space	$21 / $20	;see 6.3.1
32	ETX (end of text)	$03	

6.3.1 Status in the Data String SINEC- H1

The characters 28-31 in the data string SINEC H1 give information about the synchronisation status of the clock.

meaning of the following:

character no.:28 =	"#"	no radio synchronisation after reset, time invalid
	space	radio synchronisation after reset, clock at least in crystal operation
character no.: 29 =	"*"	time from the internal crystal
	space	time from radio reception
character no.: 30 =	"S"	daylight saving time
	space	standard time
character no.: 31 =	"!"	announcement of a W/S or S/W changeover
	space	no announcement

6.3.2 Example of a Transmitted Data String SINEC H1

(STX)D:03.01.96;T:1;U:12.34.56; _ _ _ _ (ETX) **(_) = Space**

radio operation, no announcement, standard time
It is Wednesday 03.01.96 - 12:34:56 h

6.4 Hopf Standard Data String String 2000

The structure of the data string is the same as the standard string and differs only in as much as the year is transmitted with 4 digits.

character no.	meaning	
1	STX (start of text)	
2	status (internal status of the clock)	; see 6.4.1
3	day of the week (1=Monday ... 7=Sunday)	; see 6.4.1
	In case of UTC time bit 3 is set to 1 in the day of the week	
4	tens hour	
5	unit hour	
6	tens minutes	
7	unit minutes	
8	tens seconds	
9	unit seconds	
10	tens day	
11	unit day	
12	tens month	
13	unit month	
14	tens century	
15	unit century	
16	tens year	
17	unit year	
18	LF (line feed)	; see 6.1
19	CR (carriage return)	; see 6.1
20	ETX (end of text)	

6.4.1 Data String 2000 Status- and Day of the Week Nibble

The second and third ASCII-characters contain the status and the day of the week . The status is decoded binaurally. Structure of these characters:

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	no announcement hour
	x	x	x	1	announcement (ST-WT-ST)
	x	x	0	x	standard time (WT)
	x	x	1	x	daylight saving time (ST)
	0	0	x	x	time/date invalid
	0	1	x	x	crystal operation
	1	0	x	x	radio operation
	1	1	x	x	radio operation (high accuracy)
day of the week nibble:	0	x	x	x	CEST/CET
	1	x	x	x	UTC - time
	x	0	0	1	Monday
	x	0	1	0	Tuesday
	x	0	1	1	Wednesday
	x	1	0	0	Thursday
	x	1	0	1	Friday
	x	1	1	0	Saturday
	x	1	1	1	Sunday

6.4.2 Example of a Transmitted Data String 2000

(STX)E312345603011996(LF)(CR)(ETX)

radio controlled operation (high accuracy)
daylight saving time
no announcement
It is Wednesday 03.01.1996 - 12:34:56 h.
( ) - ASCII-control characters e.g. (STX)

6.5 Data String T-String

The T-string can be transmitted in all modes (e.g. **forerun** or **last control characters on the second change**).

The data string can be requested by "**T**".

character no.	meaning	value (value range)
1	"T" ASCII T	$54
2	":" colon	$3A
3	tens year	$30-39
4	unit year	$30-39
5	":" colon	$3A
6	tens month	$30-31
7	unit month	$30-39
8	":" colon	$3A
9	tens day	$30-33
10	unit day	$30-39
11	":" colon	$3A
12	tens day of the week	$30
13	unit day of the week	$31-37
14	":" colon	$3A
15	tens hour	$30-32
16	unit hour	$30-39
17	":" colon	$3A
18	tens minute	$30-35
19	unit minute	$30-39
20	":" colon	$3A
21	tens seconds	$30-36
22	unit seconds	$30-39
23	CR (carriage return)	$0D
24	LF (line feed)	$0A

6.5.1 Example of a Transmitted Data String T-String

T:96:01:03:03:12:34:56(CR)(LF)

It is Wednesday 03.01.96 - 12:34:56h

6.6 Master/Slave-String

This master /slave string can be used to synchronise slave systems with the time data of the master system up to an accuracy of ± 0.5 msec. It differs from the DCF-slave-string in as much as the UTC time is included in the transmission.

The difference time is transmitted in hours and minutes following the year. The transmission is done in BCD. The difference time may be up to ± 11.59 h.

The sign is shown as the highest bit in the hours.

logic "1" = local time before UTC
logic "0" = local time after UTC

Example :

90.00	difference time	+ 10.00 h.
01.30	difference time	– 01.30 h.
81.30	difference time	+ 01.30 h

The whole data string shows the following structure:

character no.	meaning	value (value range)	
1	STX (start of text)	$02	
2	status	$30-$39,$41-$46	; see 6.6.1
3	day of the week	$31-$37	; see 6.6.1
4	tens hour	$30-32	
5	unit hour	$30-39	
6	tens minute	$30-$35	
7	unit minute	$30-$39	
8	tens second	$30-36	
9	unit second	$30-39	
10	tens day	$30-33	
11	unit day	$30-39	
12	tens month	$30-31	
13	unit month	$30-39	
14	tens year	$30-39	
15	unit year	$30-39	
16	tens diff.time + sign hour	$30$31,$38,$39	
17	unit diff.time + hour	$30-39	
18	tens diff. time minutes	$30-35	
19	unit diff. time minutes	$30-39	
20	LF (line feed)	$0A	; see 6.1
21	CR (carriage Return)	$0D	; see 6.1
22	ETX (end of text)	$03	

6.6.1 Status in the Data String Master-Slave

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	no announcement hour
	x	x	x	1	announcement (ST-WT-ST)
	x	x	0	x	standard time (WT)
	x	x	1	x	daylight saving time(ST)
	x	0	x	x	no announcement leap second
	x	1	x	x	announcement leap second
	0	x	x	x	radio operation
	1	x	x	x	radio operation (high accuracy)
day of the week nibble	0	0	0	1	Monday
	0	0	1	0	Tuesday
	0	0	1	1	Wednesday
	0	1	0	0	Thursday
	0	1	0	1	Friday
	0	1	1	0	Saturday
	0	1	1	1	Sunday

6.6.2 Example of a Transmitted Data String Master-Slave

(STX)831234560301968230(LF)(CR)(ETX)

Radio operation, no announcement, standard time
It is Wednesday 03.01.96 - 12:34:56 h
The difference to UTC is +2.30 hours

6.6.3 Settings

The following setting is required for the synchronisation of the **hopf** slave-systems:

- output every minute
- output second advance
- ETX on the second change
- 9600 baud, 8 bit, 1 stop bit, no parity

According setting for modebyte 1: **1000 0101**

Under this setting the time base is controlled perfectly in the slave systems.

PLEASE NOTE : *FOR SPECIAL APPLICATIONS THE OUTPUT OF THE UTC TIME CAN BE ACTIVATED IN MODEBYTE 1.*

6.7 Data String IBM 9037 Sysplex Timer

This data string is used to synchronise the IBM 9037 Sysplex Timer. The 9037expects the time at its output every second. The following settings are required:

9600 baud, 8 data bit, parity odd, 1 stop bit, transmission on request without second advance and control characters.

When the Sysplex Timer is switched on it transmits the ASCII character "C" to the connected radio controlled clock, so that the protocol in the table below is put out automatically every second.

The setting UTC or local time are optional.

character no.:	meaning	value (value range)	
1	SOH (start of header)	$02	
2	hundred- current day of year	$30-33	
3	tens -current day of year	$30-39	
4	unit -current day of year	$30-39	
5	":" colon	$3A	
6	tens hour	$30-32	
7	unit hour	$30-39	
8	" : " colon	$3A	
9	tens minute	$30-35	
10	unit minute	$30-39	
11	" : " colon	$3A	
12	tens second	$30-35	
13	unit second	$30-39	
14	quality identifier	$20,41,42,43,58	
15	CR (carriage return)	$0D	; see 6.1
16	LF (line feed)	$ 0A	; see 6.1

6.7.1 Status in the Data String Sysplex Timer

Character number 14 informs about the synchronisation status of the clock. Possible values and their meaning are listed below.

"?"	=	question mark	=	no radio controlled time at hand
" "	=	space	=	radio controlled time at hand
"A"	=	Hex 41	=	crystal operation for more than 20 minutes
"B"	=	Hex 42	=	crystal operation for more than 41 minutes
"C"	=	Hex 43	=	crystal operation for more than 416 minutes
"X"	=	Hex 58	=	crystal operation for more than 4160 minutes

6.7.2 Example of a Transmitted Data String Sysplex Timer

(SOH)050:12:34:56 _ (CR) (LF) (_) = Space

radio controlled operation , 12:34:56 h, 50th day of the year

7 Pin Allocation of Serial Interfaces

7.1 Pin Allocation of the 25 pole SUB-D female Connector COM 0

25-pole SUB-D female connector - pin no.	allocation			64-pole VG-strip pin no.
1		free		free
2	TxD	(transmit data)	RS232c	2a
3	RxD	(receive data)	RS232c	3a
4	RTS	(ready to send)	RS232c	4a
5	CTS	(clear to send)	RS232c	5a
6		free		free
7	0V	GND		7a
8		free		free
9		free		free
10		free		free
11	TxD	(transmit data)	RS422	10a
12	/TxD	(transmit data)	RS422	11a
13		free		free
14		free		free
15		free		free
16		free		free
17		free		free
18		free		free
19		free		free
20		free		free
21		free		free
22	RxD	(receive data)	RS422	12a
23	/RxD	(receive data)	RS422	13a
24		free		free
25		free		free

7.2 Pin Allocation of the 9 pole SUB-D female Connector COM 1

9-pole SUB-D female connector - pin no.	allocation			64-pole VG-strip pin no.
1	GND			7c
2	TxD	(transmit data)	RS232c	2c
3	RxD	(receive data)	RS232c	3c
4	/RxD	(receive data)	RS422	13c
5	RxD	(receive data)	RS422	12c
6	RTS	(ready to send)	RS232c	4c
7	CTS	(clear to send)	RS232c	5c
8	TxD	(transmit data)	RS422	10c
9	/TxD	(transmit data)	RS422	11c

8 Technical Data Basic System

operating voltage:	standard:	230 V AC +10% -15%
	option:	120 V AC +10% -15%
		110 V DC (60V - 120V)
		60 V DC (38 V - 75V)
		24 V DC (18 V - 36V)
power consumption device fully equipped:		50 VA
display:		LCD-display 2x16 digits
type of display:		alphanumeric
height of digits:		5 mm
crystal accuracy:		± 0.02 ppm
		after GPS control and constant temperature
back-up clock accuracy:		± 25 ppm at 25° C
back-up clock buffering maintenance free:		3 days
key-pad:		25 keys
DCF77-simulation output:		3 mVss at 50 Ohm load

8.1 Technical Data GPS -Receiver

type of receiver		6 channel phase-tracking receiver
decoding:		L1 frequency 1.575,42 MHz, C/A-Code
sensitivity:		-143 dB
synchronisation time	cold start:	30 min. - 4 h.
		(first installation without position data)
	warm start:	ca. 1 min.
		(voltage failure < 3 days)
accuracy of the PPS-pulse:		± 1 microsecond (95%)
temperature range:		0 ... 60° C

8.2 Technical Data Antenna

type of antenna:	micro-strip-antenna
mid-frequency:	1.575,42 MHz
band width:	10 MHz
antenna amplifier	
voltage supply:	+5 V ± 0,5 V (via antenna cable)
impedance:	50 Ohm
power amplifier:	20 dB
length of cable:	max. 25 m - with special cable 50 m
	max. 150 m with power amplifier
temperature range:	-30°C to +85°C

special requirements: hard- and software alterations according to customer specifications are possible

PLEASE NOTE : *THE* **HOPF** *COMPANY WITHHOLDS THE RIGHT TO ANY ALTERATIONS IN HARD- AND SOFTWARE. THE NAMES IBM, SIEMENS, WINDOWS ETC. USED IN THIS DOCUMENT ARE REGISTERED TRADE NAMES OF THE ACCORDING COMPANIES.*

Technical Description

LAN Board

7270

hopf Elektronik GmbH

Version 03.00 **01.09.2000**

Safety information

The safety regulations and technical data are important for the smooth running of the devices and the protection of people and equipment. Strict compliance with these regulations is required. In case of non-compliance with these regulations the guarantee and warranty claims for the device and possible consequential damage expire.

Safety of the Devices

The production of this device follows the latest technological standards and safety regulations.

The device must not be assembled by anyone but trained personnel. Please make sure that all the connected cables are laid and fixed properly. The device is to be run with the supply voltage stated on the identification plate only.

Only trained personnel or specialists may operate the device.

Repair on opened devices must not be carried out by anyone but specially trained staff or by the **hopf** company.

If the maintenance work requires the opening of a device or if a fuse needs changing the device must be separated from all voltage supplies.

If there are reasons to believe that the operational safety can no longer be guaranteed the device must be taken out of service and labelled accordingly. The safety may be impaired when the device does not operate properly or if it is obviously damaged.

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1 General Information

The network-interface board can be integrated into the **hopf** GPS or DCF77 systems 6855, 6842 and 7001. The time is supplied via the 10BaseT Ethernet interface (LAN).

The board supports the widely used time protocols NTP version 3.x and a special broadcast-protocol for the SINEC LAN-bus.

2 Hardware Requirements

2.1 Ethernet Interface Board

This device can be installed at any position within the network. It is connected by means of suitable interfaces and cables.

2.2 Configuration of the LAN-Interface Systems 6842 / 6855

The LAN-board is configured by the key-pad of the controlling systems 6855, 6842 or 7001GPS by entering the necessary parameters like IP-address, gateway-address, net-mask and a general control byte.

The configuration is based on the respective system manuals. Hereinafter only the entering of these values under the menu item **"SET"** is explained. The English version of the menu dialogue is displayed. The system 6855 can also be changed to German dialogue.

> ***PLEASE NOTE :*** *AFTER ALL THE LAN SPECIFIC POINTS HAVE BEEN SET VIA THE **"SET"**-MENU" YOU MUST LEAVE IT BY PRESSING **"BR"** WHEN THE **"ENT"** KEY WAS USED FOR THE LAST TIME. IT IS ONLY THEN THAT THE INFORMATION IS TRANSFERRED TO THE RESPECTIVE LAN BOARD.*

2.2.1 IP-Address

An IP-address is a 32 bit value, divided into four octets of eight bits each. The standard representation is four decimal numbers (between 0 and 255) separated by points.

Example: 192.2.1.123

The IP-address is divided into two parts, a network and a host part. Due to different requirements, four common "network classes" has been defined. Depending on the network class, the last one, two or three bytes define the host, the others the network.

In the following part „x" stands for the host part of the IP-address.

Class A Networks

IP-address 1.xxx.xxx.xxx to 127.xxx.xxx.xxx

This class consists of 127 different networks at the most. This enables a very high quantity of connectable units (at the most 16.777.216).

Example: 10.0.0.1, (Network 10, Host 0.0.1)

Class B Networks

IP-address 128.0.xxx.xxx to 191.255.xxx.xxx

This class consists of 32768 networks at the most. Each of these networks can consist of up to 65534 devices.

Example: 172.1.3.2 (Network 172.1, Host .3.2)

Class C Networks

IP-address 192.0.0.xxx to 223.255.255.xxx

These network addresses are the most common ones. Up to 256 devices can be connected.

Class D Networks

The address from 224.xxx.xxx.xxx -239.xxx.xxx.xxx are used as multicast-addresses.

2.2.1.1 Exceptions

- No permit for addresses setting the 4 bits of the highest value to 1-1-1-1 (240.xxx.xxx.xxx - 254.xxx.xxx.xxx). These addresses are named "class E" and are reserved.
- The host address where all bits are "0" is used to address the entire network (e.g. for routings).
- The address of the host part where all bits are "1" is the broadcast address which means every client will be addressed.
- It is not allowed to use network and broadcast addresses as a host address:

  e.g.. 192.168.0.0 describes the whole network
  192.168.0.255 describes the broadcast address

2.2.2 Gateway-Address

The gateway- or router-address is required to communicate with other LAN segments. The standard gateway has to be adjusted to the address of the router, connecting this segment. The address has to be within the local network.

2.2.3 Net-mask

The net-mask is used to split IP-addresses outside the network classes A, B, C. By entering the net-mask it is possible to indicate how many bits of the IP-address are used as a part of the network and a part of the host.

e.g.:	Standard Class A	8 Bit Network	24 Bit Host Part	Net- mask	255.0.0.0
	Standard Class B	6 Bit Network	16 Bit Host Part	Net- mask	255.255.0.0
	Standard Class C	24 Bit Network	8 Bit Host Part	Net- mask	255.255.255.0

2.2.4 Control Byte

Different functions, e.g. time base, standard, NTP or SINEC-LAN etc. will be activated by the control byte.

The bits have the following meaning

Bit 7

Bit 7 not in use yet.

Bit 6

Bit 6 is used to set the format of the protocol which is to be putout.

Bit 6 = 0 output format NTP protocol
Bit 6 = 1 output format SINEC protocol

Bit 5/4

Bits 5/4 can be used to choose either one of two Mac-addresses or the broadcast address if **"SINEC Protocol"** is set.

Bit 5	Bit 4		
0	0	Mac-address 1	09 00 06 03 FF EF
0	1	Mac-address 2	09 00 06 01 FF EF
1	0	broadcast-addr.	FF FF FF FF FF FF

When **"NTP Protocol"** is set these bits are of no consequence.

Bit 3/2

Bits 3 and 2 can be used to set the transmission interval when **"SINEC Protocol"** is set.

Bit3	Bit2	
0	0	1 sec.
0	1	10 sec.
1	0	60 sec.
1	1	60 sec.

When **"NTP Protocol"** is set these bits are of no consequence.

Bit 1/0

Bits 1 and 0 fix the time base for the protocols.

Bit1	Bit0	
0	0	local time with possible points of changeover
0	1	local standard time
1	0	UTC
1	1	special time. This setting is not in use yet. In this setting the local time is put out.

2.3 Input Function 6842/6855

2.3.1 IP-Address

The IP-address is entered via the following selection pictures

SET LAN 1	**or**	**SET LAN 2**
ADR. Y/N		**ADR. Y/N**

After entering (**Y**)es the display changes to the entry picture

LAN 1 >

Now the IP-address can be entered in four groups of three decimal numbers between 0-255. The entry must have three digits (e.g. 1 ⇨ 001). After 3 digits a (**.**) is set automatically. After the last group of numbers a limiting arrow is added (**<**). "**ENT**" completes the entry.

A complete entry may look as follows:

LAN 1 >100.010
010.003<

This example shows the IP-address **100.010.010.003** pre-set by our company.

2.3.2 Input Gateway-Address

The gateway-address is entered via the following selection picture:

SET LAN 1	**or**	**SET LAN 2**
GATEWAY ADR. Y/N		**GATEWAY ADR. Y/N**

After entering (**Y**)es the display changes to the entry picture

LAN 1 >

Now the gateway-address can be entered in the same form like the IP-address.

2.3.3 Input Net-mask

For the calculation of the net-mask the quantity of bits for the host part will be entered. It ranges between 2 - 31.

e.g.:	Net-mask	input host	bits
	255.255.255.252	(FF FF FF FC)	2
	255.255.255.128	(FF FF FF 80)	7
	255.0.0.0	(FF 00 00 00)	24

2.3.4 Input of Control Byte

The control byte can be used for various settings.

The control byte is entered via the following selection pictures:

SET LAN 1	**or**	**SET LAN 2**
CNTRL.-BYTE Y/N		**CNTRL.-BYTE Y/N**

After entering (**Y**)es the display changes to the entry picture

BIT 7654 3210

_

Only a "**0**" or a "**1**" can be entered for the individual bits in the second line.

> ***PLEASE NOTE :*** *AFTER ALL THE LAN SPECIFIC POINTS HAVE BEEN SET VIA THE **"SET"**-MENU" YOU MUST LEAVE IT BY PRESSING **"BR"** WHEN THE **"ENT"** KEY WAS USED FOR THE LAST TIME. IT IS ONLY THEN THAT THE INFORMATION IS TRANSFERRED TO THE RESPECTIVE LAN BOARD.*

2.4 Bus Identification

Switch 7 of DIP-Switch 1 selects either the bus of system 7001 or one of the buses of the boards (systems) 6855 / 6842.

S7	
on	bus 7001
off	bus 6855 / 6842

2.5 Input Functions System 7001

The input or display functions are called by means of menu point LAN=6.

The following start picture is shown:

SELECT LAN-BOARD NO. 1- 8 INPUT --> _ <--

The system 7001GPS can be used to configure up to 8 LAN-boards. A digit between 1-8 must be entered.

2.5.1 IP-Address

When the number of the board is entered the display moves to the SET-menu for the IP-addr.

BOARD --> 1 <-- IP-ADR. > 100.010.010.003 <
NEW INPUT WITH "Y" > <

The top line shows the entered number of the board and the IP-Address which is set at the time. Entering a new address requires the entry of **Y**(es). The entry of an octet must always have 3 digits e.g. 100.10.10.3 must be entered as

100.010.010.003

"ENT" completes the entry. The new address is shown in the top line. In case of a wrong entry this menu is left and an error message is given.

2.5.2 Input Gateway-Address

With each other digit- or letter input except **"Y"** and **"BR"** a continuous running to the next menu item for the card takes place. The next point shown deals with the handling of the Gateway or Router addr.

BOARD --> 1 <-- GW-ADR. > 191.124.010.001 <
NEW INPUT WITH "Y" > _ <

For entry follow instructions under pt. 2.4.1.

2.5.3 Input Netmask

The number of bits for the host part must be entered to calculate the netmask. It ranges between 2-31.

e.g.	netmask	entry host	bits
	255.255.255.252	(FF FF FF FC)	2
	255.255.255.128	(FF FF FF 80)	7
	255.0.0.0	(FF 00 00 00)	24

The entry mask shows

BOARD --> 1 <-- NET MASC > 16 <
NEW INPUT WITH "Y" >_ <

"ENT" completes the entry. The new mask is shown in the top line. If the entry is false the menu is left and an error message is given.

2.5.4 Input Control Byte

The control byte is used for various settings.

The control byte is entered in the menu

BOARD --> 1 <-- CNTR-BYTE > 00100010 <
NEW INPUT WITH "Y" >_ <

When (**Y**)es is entered a **"0"** or a **"1"** can be entered for each bit (see pt. 2.2.4).

PLEASE NOTE : *AFTER ALL THE LAN SPECIFIC POINTS HAVE BEEN SET VIA THE **"SET"**-MENU" YOU MUST LEAVE IT BY PRESSING **"BR"** WHEN THE **"ENT"** KEY WAS USED FOR THE LAST TIME. IT IS ONLY THEN THAT THE INFORMATION IS TRANSFERRED TO THE RESPECTIVE LAN BOARD.*

2.6 Board Identification

The systems 6855, 6842 can address two and the system 7001GPS can address eight LAN-boards. The boards are identified by means of DIP-switch 1, switches 1-4.

S4	S3	S2	S1	
on	on	on	on	board 1
on	on	on	off	board 2
on	on	off	on	board 3
on	on	off	off	board 4
on	off	on	on	board 5
on	off	on	off	board 6
on	off	off	on	board 7
on	off	off	off	board 8

2.7 Minute Pulse

It is possible to get a potential free minute pulse with a voltage of +12 VDC at the 9-pole SUB-D connector. The pulse output can be set in 4 steps:

Pin 1: + 12 V pulse

Pin 9: 0 V

PLEASE NOTE : *THE OUTPUT MUST HAVE A LOADING OF 20 MA BECAUSE OTHERWISE THE SLOPE RATE IS TOO SMALL.*

The pulse outputs are set by means of DIP-switch 1 as follows:

S6	S6	
on	on	10 msec
on	off	100 msec
off	on	500 msec
off	off	1000 msec

2.8 NTP

The network clock operates in the server mode. No symmetric operating modes are supported. The clock understands the frames of **NTP-Versions 1, 2 and 3.** The board can be used for up to 100 clients without overloading it. The network clock offers full support of SNTP and all NTP-functions, which are necessary for a reliable operation of the server. There are no functions implemented which are not required by the server operation.

2.9 Network Connector

The connection to the Ethernet (LAN) is made via the RJ45 connector on the front panel.

The connector has the following assignment:

1	TXD +
2	TXD –
3	RXD +
6	RXD –

2.10 LED Status- and Error Codes

There are 5 LEDs on the front panel for status and error messages.

S-LED flickers:	rule, shows access to the internal bus
S-LED permanently lit :	error on the board
S-LED off	error on another board. Bus access no longer possible

LED 1-4

After the initial self-testing period (2-3 sec.), where all the LEDs (1-4) should be lit, the LEDs indicate the status of the network on the board.

LED **1** lit:	Synchronisation with the time signal, correct reception of the time data. System is radio synchronous.
LED **1** flashing:	The time data string is being received. But the system is not radio synchronous.
LED **1** off:	No time data string is being received
LED **2** flashing:	Fault in the connection to the basic board
LED **2** off:	Connection built up
LED **3**	Ethernet-CPU in up-date mode
LED **4** lit:	Net connection via the RJ45-connector OK
LED **4** off:	Net connection is incorrect or cable has a defect.

3 Technical Data

network interface:	10-Base T
power supply:	5 V ± 5%, 600 mA
temperature range:	0 - 70° C

Technical Description

General Information on the System

Appendix GPS

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1 How GPS works

At a height of about 20,000km satellites circle around the earth twice a day on different orbits and angles (see picture below).

The GPS system[1] had been developed on the basis of 18 satellites with 3 spare ones. In the course of time this number was increased to 21 plus 3 spare ones to cover possible gaps in the coverage. Therefore 6 to 11 satellite are visible from any point on earth all the time. On board every satellite there is an atomic clock (accuracy at least 1×10^{-12}) .

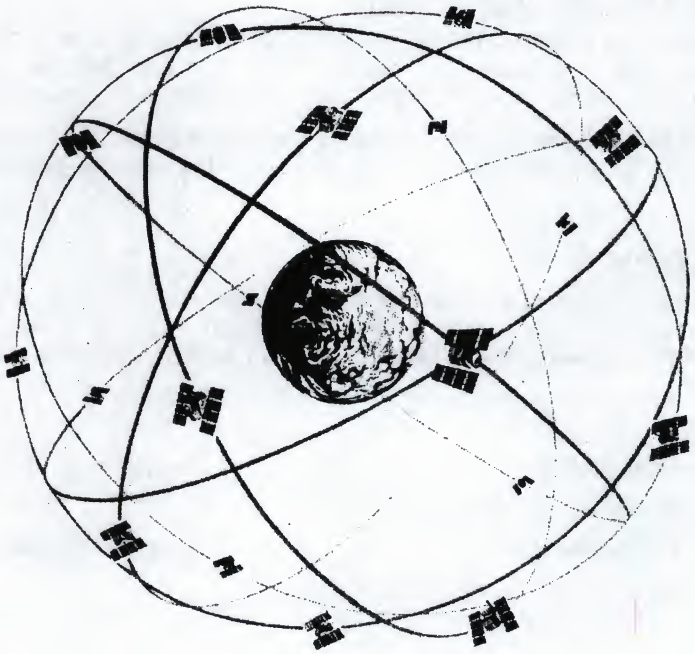
A basic frequency of 10.23 MHz is derived from the frequency of the atomic clock. The two carrier frequencies L1 and L2 are produced from this basic frequency.

- transmission frequency L1 = 154 * basic frequency 1575.42 MHz
- transmission frequency L2 = 120 * basic frequency = 1227.60 MHz

Every satellite broadcasts by modulation all the important navigation and system data on these two carrier frequencies. The data of the frequency L1 may be decoded for civil purposes. The exact time can be calculated from these data and the position defined via the antenna.

The GPS antenna receives signals from all the satellites visible above the horizon and passes them on to the GPS receiver through a coaxial cable. Four satellites are required for a continuous time decoding.

The world-time UTC[2] is calculated by subtracting the leap seconds from the GPS-world-time (GPS-UTC), at present (1992) the world-time lags 7 seconds behind GPS-UTC. The difference is not constant, it changes with every insertion of a leap second.



[1] GPS = global positioning system
[2] UTC = universal time coordinated

2 Accessories

2.1 GPS-Antenna

Due to the high signal frequency of about 1.5 GHz an outdoor antenna is always required for the reception of the GPS satellite data.

2.1.1 Where to install the antenna

As the antenna is to receive data from all directions it must be non-directional. And due to the high frequency there must be "visual contact" to the satellites.

Visual contact means that no massive and large things (buildings) block the view to the horizon. Rain, fog and clouds as well as small things e.g. chimneys at a certain distance impair the view inconsiderably. Please choose the location of the antenna so that at least 4 satellites are constantly visible.

As a rule: *The larger the visible section of the sky, the longer the following electronics stay radio synchronous.*

2.1.2 Mechanical Structure of the Antenna

The antenna is housed in a round weatherproofed plastic casing. The casing cover is arched, so it prevents any rain water, snow or other polluting substances from resting on the antenna.

The mechanical construction consists of rigid, anodized aluminium or aluminium die-casting and is designed to resist high winds.

The plastic housing can be installed horizontally as well as vertically to the mechanics allowing both wall and flat-roof installation of the antenna (see drawing). The antenna cable can be fed either through the foot part or through a slot on the side of the mounting flange.

2.1.3 Electrical Structure of the Antenna

As the antenna is not directional at all, improved reception cannot be derived by means of mechanical shaping as, for example, with parabolic antennas e.g. Therefore the signal strength at the antenna input is about 1 x 10 E-16 Watt and already below the general noise level.

An extremely low-noise pre-amplifier is placed behind the antenna in order to feed the signals to the electronics via an antenna cable. The antenna cable also supplies the voltage to the pre-amplifier.

2.1.4 Antenna Cable

The cable length is limited due to the high frequency and the low signal strength. Introducing an intermediate amplifier it can be about double the length. At present, two different types of cables are available allowing the following distances between antenna and electronics to be bridged.

- standard cable RG59 **length max. 25m**
  (attenuation loss at 1.5 GHz 52 dB/100m)
- ***hopf*** GPS special cable **length max. 50m**
  (attenuation loss at 1.5 GHz 28 dB/100m) :

Inserting an intermediate amplifier into the antenna cable allows the following cable lengths.

- standard cable RG59 plus amplifier : **length max. 100m**
- ***hopf*** GPS special cable plus amplifier : **length max. 150m**

2.1.5 Cable-Installation

When laying the cable beware the following problems:

- do not damage or soil the coaxial connectors or couplings. If necessary protect the connection with plastic foil.
- the bending radius of the cable must not be smaller than 10 cm .
- the cable must not be crimped or the skin be damaged at any place.

A coupling connects the cable to the antenna plate foot. This coupling may be opened to lay the cable. Just undo the Allen screws on the plate foot and lift this off (see drawing in the appendix).

Please note : Do not lay the cable next to other HF-, control or power cables.

The leakage from these cables may interfere with the GPS reception because of the extremely low reception power.

2.2 General Information about Lightning Protection

Using outdoor antennas increases the danger of very high interference voltages or current pulses in the antenna cable during thunder storms. This may result in not only damaging or destroying the directly connected radio controlled clock system but also the connected devices.

To avoid high costs for damage and damage related costs an indirect lightning protection should be built in between the outdoor antenna and the radio clock circuit board.

2.2.1 Causes of Overvoltages

Buildings can be protected by the lightning conductor developed by Benjamin Franklin. This though does not protect the electronic devices inside from indirect consequences of the flash.

A flash of lightning is nothing but an overdimentional short circuit of two lines with different potentials. In case of a flash of lightning it is usually two layers of clouds or one layer of cloud and the earth. A current of 1000 to 100000 ampere then circle between clouds or between cloud and earth. This produces the following indirect disturbing or destructive influences on the unprotected devices connected to open lines (antenna, antenna cable).

2.2.2 Electrostatic Field

The increase of the electrostatic field up to 50 kV/m can be causes by close potential-loaded thunder clouds or by the static charging of the air. The change in field accrue in a flash producing high-frequency, electromagnetic micro-pulses.

2.2.3 Increase of the Earth Potential

The entry of a lightning flash into the ground causes a quick increase of the earth potential which depends on the power of the current and on the local specific resistance of the earth. This overvoltage reduces itself as the waves flow through the ground and causes high voltage-potential differences in unprotected devices.

2.2.4 Electromagnetic Radiation

The flash of lightning may be compared to an antenna of several kilometres length. The pulse current of several kiloamperes radiates a strong electromagnetic field. This radiation induces high voltages and currents in close lines (1 to 2 km) which can also cause overvoltages in the connected devices.

2.3 Lightning Protection

Overvoltages caused by indirect effects of the flash cannot be avoided, but devices can be protected against the destructive consequences of it.

To achieve this it is necessary to "short-circuit" all the lines with overvoltage to get rid of the overvoltage as quickly as possible. When the problem is solved the device should return to its original specifications.

The **hopf** lightning protection consists of a combination of different parts. Due to the high frequency and the signal power which is below the noise level the elements must be arranged in the strip-line technique.

Fast absorber diodes with a responding time of < 1 nsec. and a discharge current of 10 kA keep the potential differences between antenna core and naught constantly on +/-6V. The subsequent double-chamber gas arrester short circuits, when ignited, the line to the earth terminal.

This combination also guarantees the potential separation of the antenna circuit of the other electronics in an undisturbed state.

If the lightning protection itself is destroyed by a flash the lines stay short circuited. A GPS signal is no longer received. We therefore advise to use the status bits of the connected devices for checking.

2.3.1 Installation

In case of using the **hopf** lightning protection we trust that on location there is a continuous lightning protection concept, including a direct lightning protection of the building according to VDE and a flash protected voltage supply of the devices.

Normally the lightning flash protection is installed where the cable enters the building. Therefore the in-house cables running parallel to the antenna cable are disturbed as little as possible.

The antenna is connected to the BNC input connector - the extended line to the electronics is connected to the BNC output connector.

A 10 mm^2 stranded wire is laid from the earthing screw to the next earth connection point. The length of the earth stranded wire should not exceed 10 m.

It is also important that the earth line of the connected device has the same earth connection point as the lightning protection, so that no destructive potential differences can arise. If this cannot be guaranteed another place of installation should be found for the lightning flash protection.

Then the lightning protection is installed near the device so that the earth connection line can be connected to the ground of the device. In case of this type of installation the antenna cable between antenna and lightning protection should not run parallel to other cables.

Please note : Only trained personnel may install the lightning flash protection.

2.4 Line Amplifier

Cable lengths above 50 m need the looping in of the line amplifier type 6849 into the antenna cable.

The looping in should be as close as possible to the antenna but behind the lightning protection.

Please note : To avoid oscillation the distance between lightning protection and line amplifier should be at least 1.5 m.

2.4.1 Mounting without Protective Housing

The line amplifier is built into an HF-proof housing with a ground plate. It is therefore easy to fix the device to the wall. The voltage is supplied through the coaxial cable - as with the antenna, so that no further connections are required.

2.4.2 Mounting with Protective Housing

A complete lightning protection concept includes the line amplifier being situated insulated in a lightning protection housing. The lid must be taken off to connect the coaxial cable which is fed through the holes on both sides and then connected to the amplifier. The lightning protection housing is earthed according to the regulation E 1024-1/1990 "Protection of Structures against lightning".

2.5 Power Splitter (2-times)

The passive Power Splitter 4443 is used to split the antenna signal into two equally strong signals to reduce the loss while operating two **hopf** GPS systems at one antenna to a minimum. The power splitter also serves to uncouple the long-distance supply of the voltage to the central conductor of the antenna.

2.5.1 Installation

The Power Splitter is set into a HF-proof housing with an insulated base plate. The unit can therefore be easily screwed to the wall near the GPS systems. The antenna must be connected to the single BNC-connector called **"Antenna in"** . On the opposite side of the housing there are the two antenna outputs to the GPS-systems.

2.5.2 Length of Cable

The smallest loss of power is achieved if the cables are of equal length after the splitting. Due to the special strip-line structure of the splitter an non-symetrical operation is also guaranteed.

The permissible length of cable is the combination of the length up to the power splitter and the length to the GPS system. These lengths should not exceed the measures given in the list of technical data.

Example:

System with ***hopf*** special cable, non-symetrical structure, length of cable up to 50m.

- antenna ⇨ lightning protection : 10 m
- lightning protection ⇨ splitter : 5 m
- splitter ⇨ device 1 : 15 m
- splitter ⇨ device 2 : 35 m

The lengths of cable to the devices are:

- device 1 = 30 m
- device 2 = 50 m

The maximum length of 50 m between antenna and device, stated in the data is not exceeded. This way the system can operate despite the fact that the total length of the cable is 65 m.

Please note : Please avoid not connecting the device to anything. This may lead to synchronisation problems in the rest of the system if the maximum length of cable is used. The free output must be closed by an HF-resistor of 50 Ω .

2.5.3 Outside Connection

It is also possible to connect a different GPS-system to a free splitting output. Please make sure that the external power supply of the antenna must not exceed 5 V DC and that the strange device also requires the original GPS-signal in L1-band.

3 Technical Data

3.1 Antenna

type of antenna :	Micro-strip-line with pre-amplifier
mid-frequency :	1575.42 MHz
band width :	2 MHz
angle of view :	+ 10° above the horizon
length of cable :	25 / 50 m max. without line amplifier 100 / 150 m with line amplifier
impedance :	50 Ohm
power amplification :	20 dB
voltage supply via the antenna cable :	5V DC ± 10 %
temperature range :	–30 to + 85° C

3.2 Lightning Flash Protection

housing :	aluminium die cast housing
size of housing :	250 x 105 x 95
input / output :	BNC-connector
earth connection point :	screw connection M6
weight :	approx. 1.8 kg
responding speed :	< 1ns
current surge pulse 8/20 µs wave form :	5 kA
protection level at 6 kV 1,5/50 µsec. wave at input :	< 12 V
input impedance :	50 Ω
insertion loss :	max. 3 dB
temperature range :	-20°C to +70°C

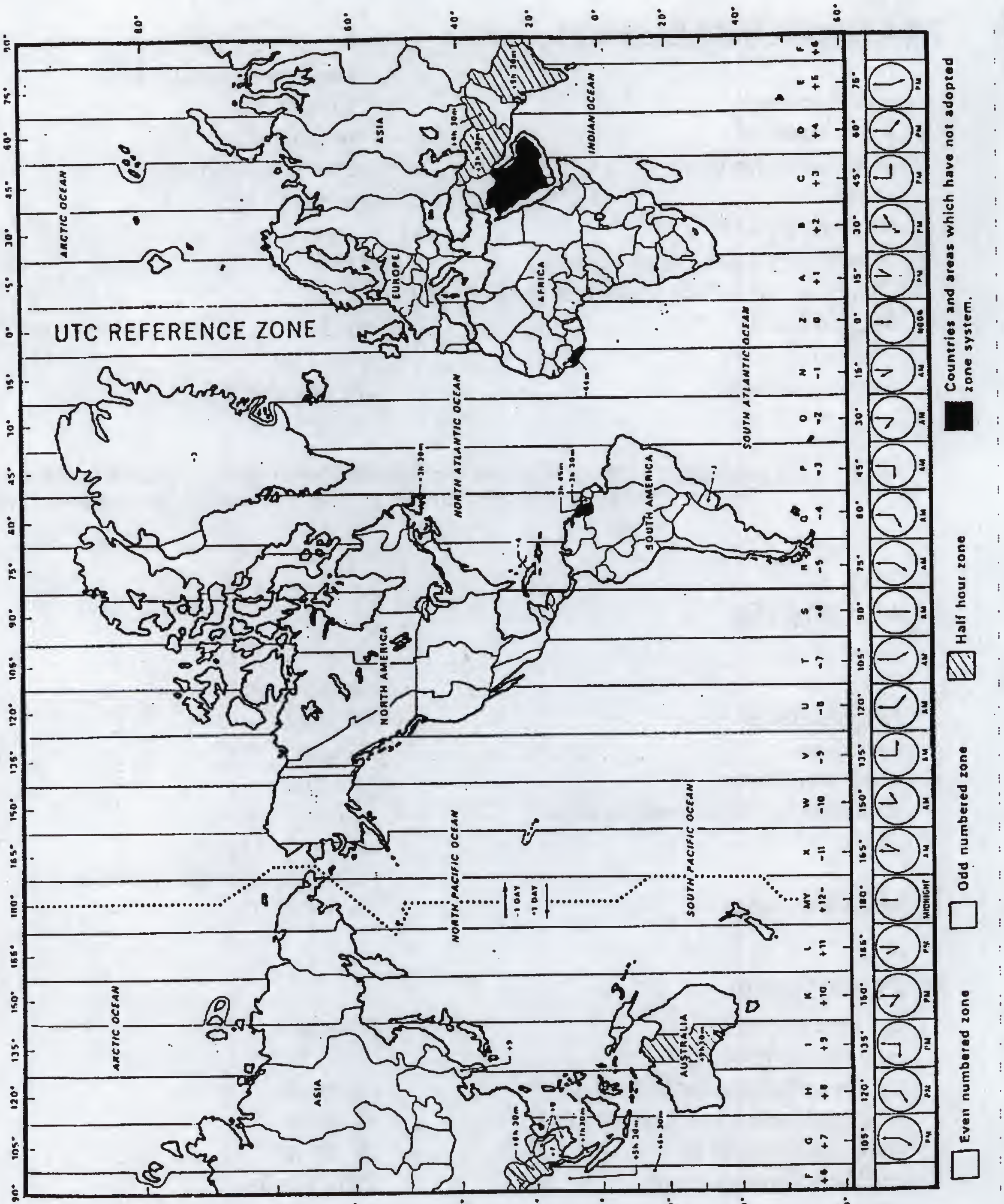
Please note : Outdoor antennas and lightning flash protection can be destroyed by lightning. We can therefore provide only a limited guarantee for these parts.

3.3 Line Amplifier

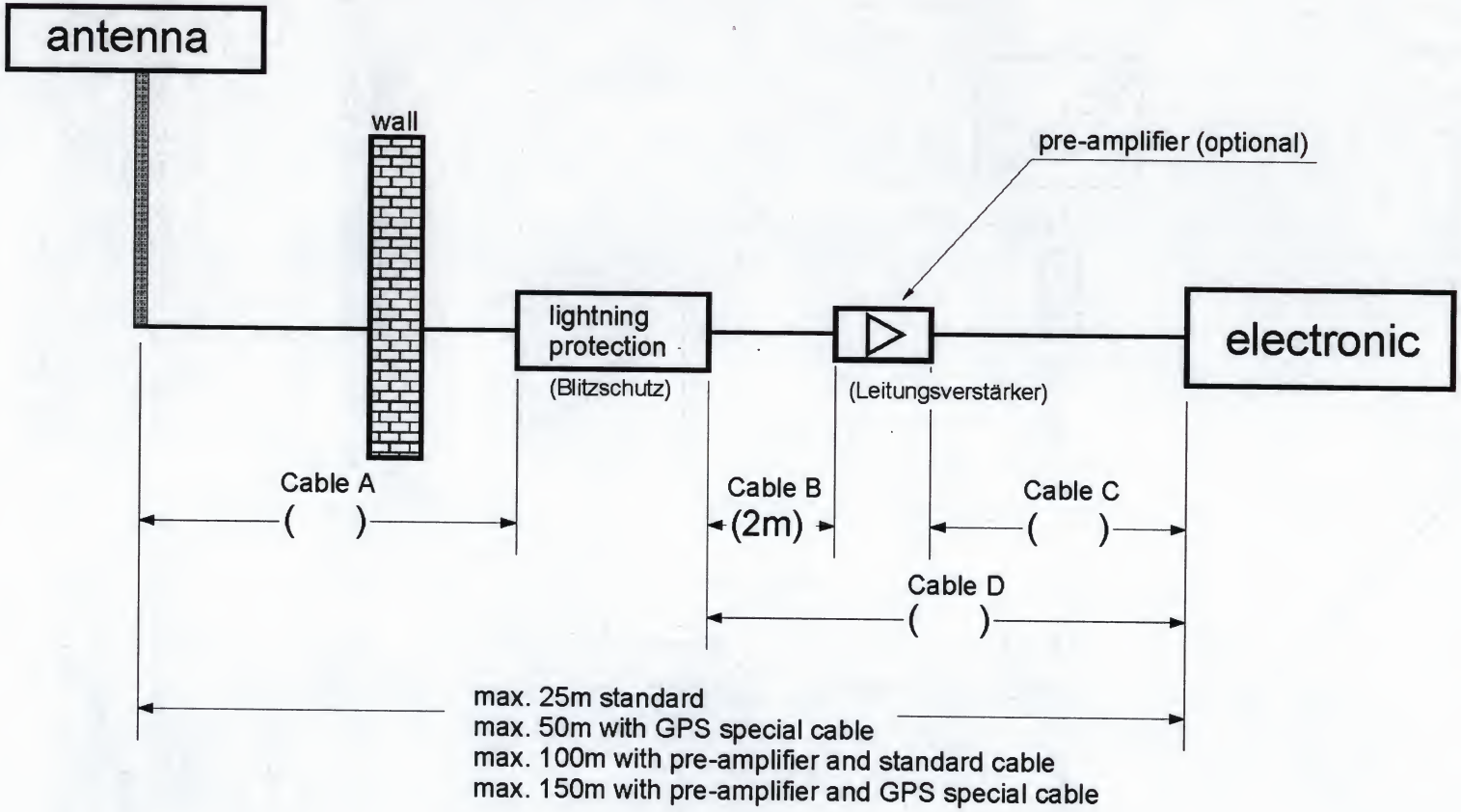
impedance :	input 50 Ω
	output 50 Ω
frequency range :	1575 MHz
band width :	± 5 MHz
power amplification :	min. 20 dB
voltage supply via the antenna cable :	5V DC ± 10 %
weight:	approx. 0,13 kg
	(1,8 kg with protection housing)
temperature range :	-10 to + 70° C

3.4 Power Splitter

operating frequency:	1575 MHz
insertion loss (S21, S31):	max. 1 dB
input reflection attenuation (S11):	22 - 26 dB
output reflection attenuation (S22,S33):	20 -26 dB
output insulation (S23):	23 - 27 dB
amplitude stability (output):	0.05 - 0.15 dB
VSWR (input):	min. 1 : 1.17 dB
external current:	max. 50 mA



no. ZC97041002			page 1/1
	Standard time zones of the world and their relationship to UTC		
	date 10.04.97	System	
	name Vollmer	hopf Elektronik GmbH	post box 1847 D-58468 Ludenscheid fon: (02351) 938686 fax: (02351) 459590
	size A4		



- standard (RG59)
- ***hopf*** GPS special cable
- pre-amplifier

( ) insert your length +/-1m

bending radius GPS special cable : min. 25mm
(Biegeradius GPS Spezial Kabel: min: 25mm)

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Cable installation GPS

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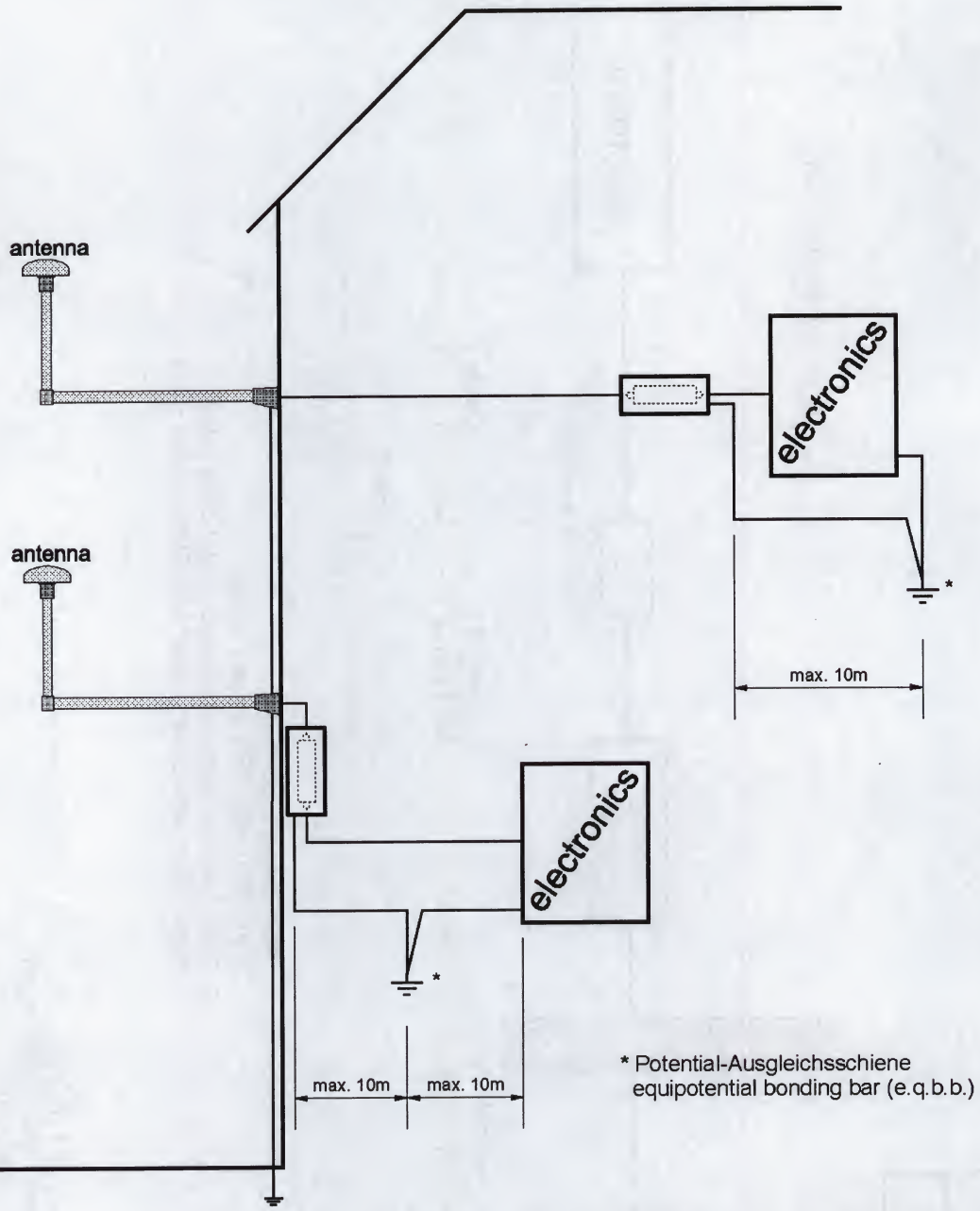

* Potential-Ausgleichsschiene
equipotential bonding bar (e.q.b.b.)

The lightning protection and the electronic must be connected on the same earth potential!
The line between lightning protection and ground must be closer than 10m.

Der Blitzschutz und die Elektronik müssen auf dem gleichen Erdpotential liegen!
Die Verbindung vom Blitzschutz zum Erdpotential darf eine Länge von 10m nicht überschreiten!

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indirect lightning protection
Indirekter Blitzschutz

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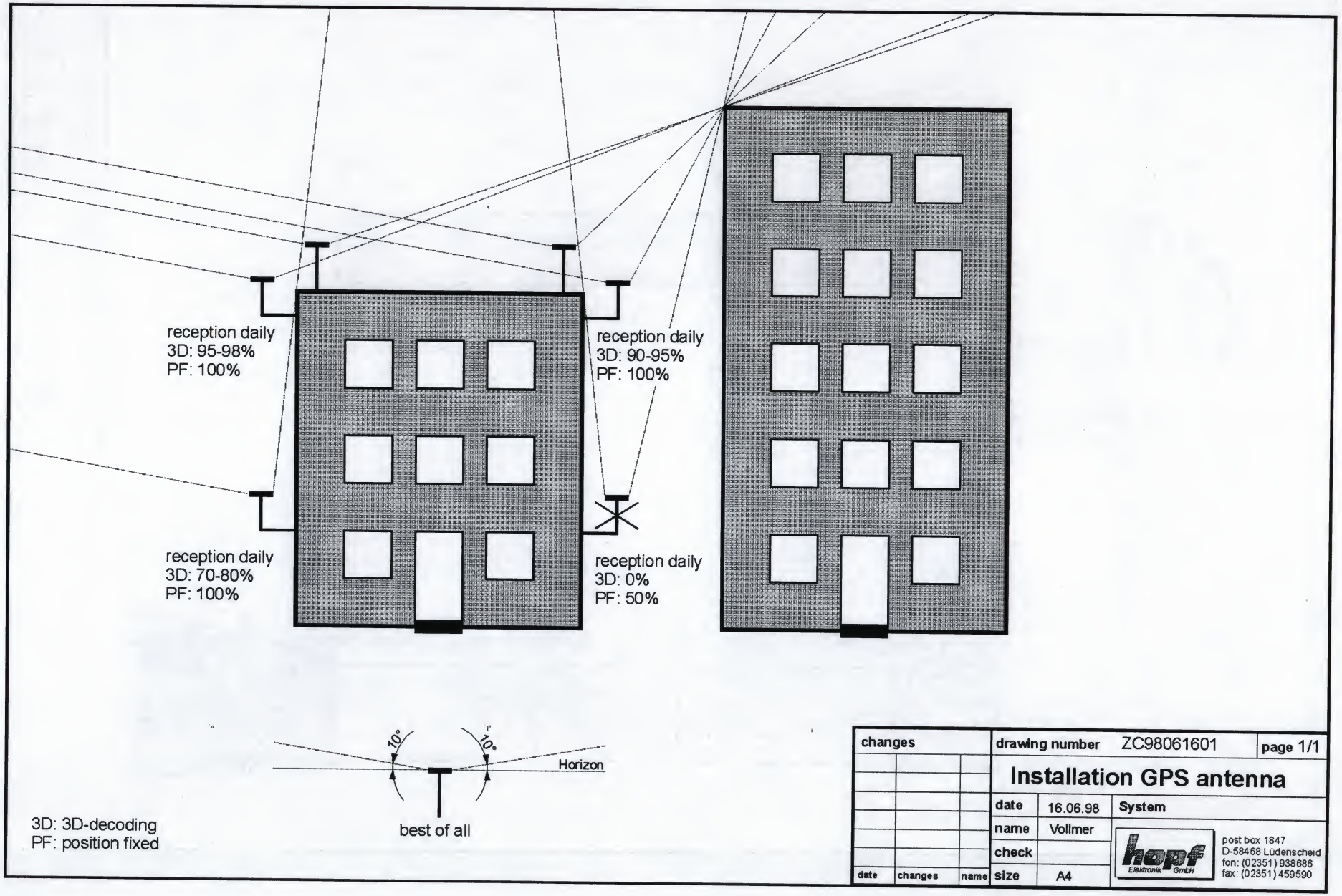

3D: 3D-decoding
PF: position fixed

changes			drawing number	ZC98061601	page 1/1
			Installation GPS antenna		
			date	16.06.98	System
			name	Vollmer	
			check		
date	changes	name	size	A4	

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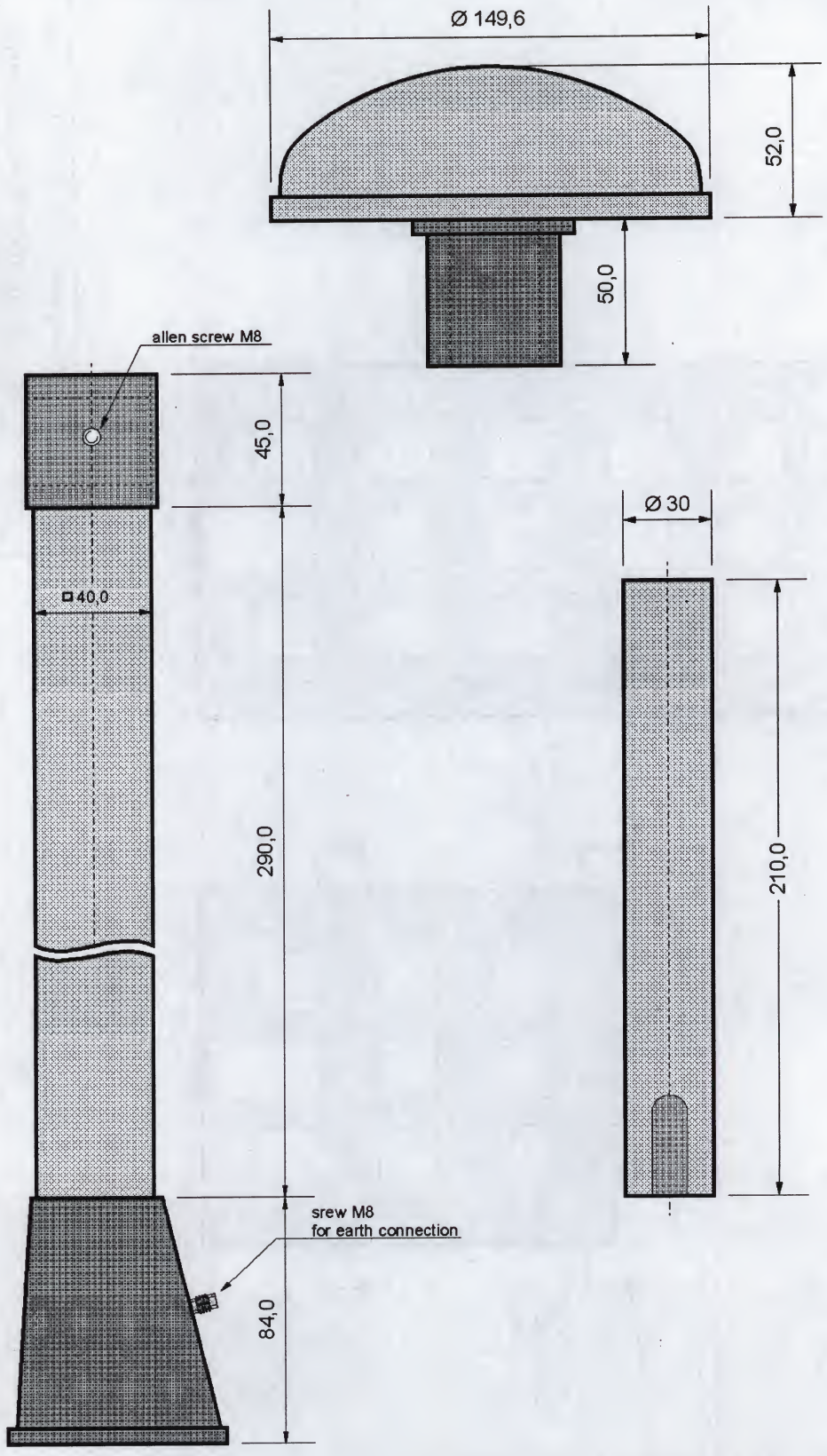

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02.06.98	Vollmer	A4	ZC98060201	1/1

GPS-Antenna

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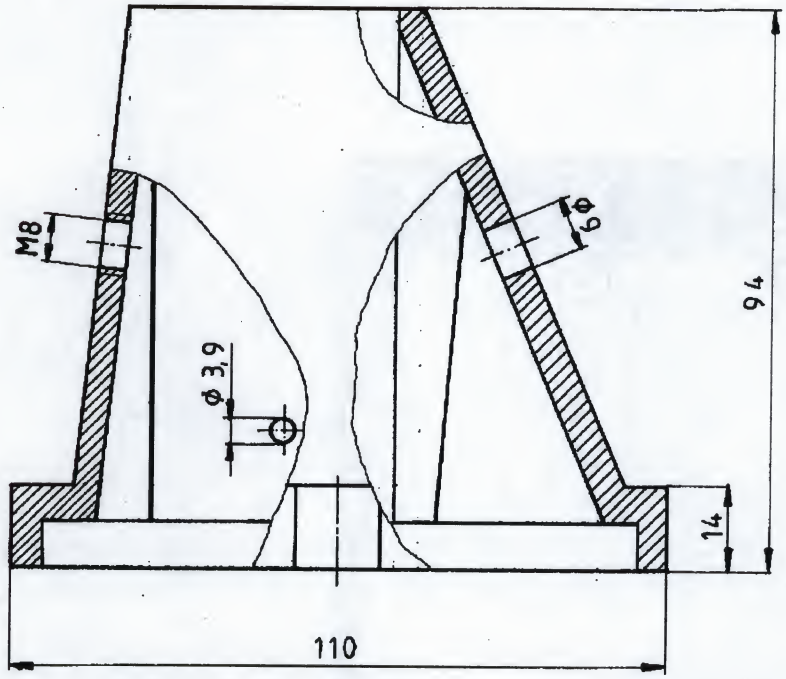

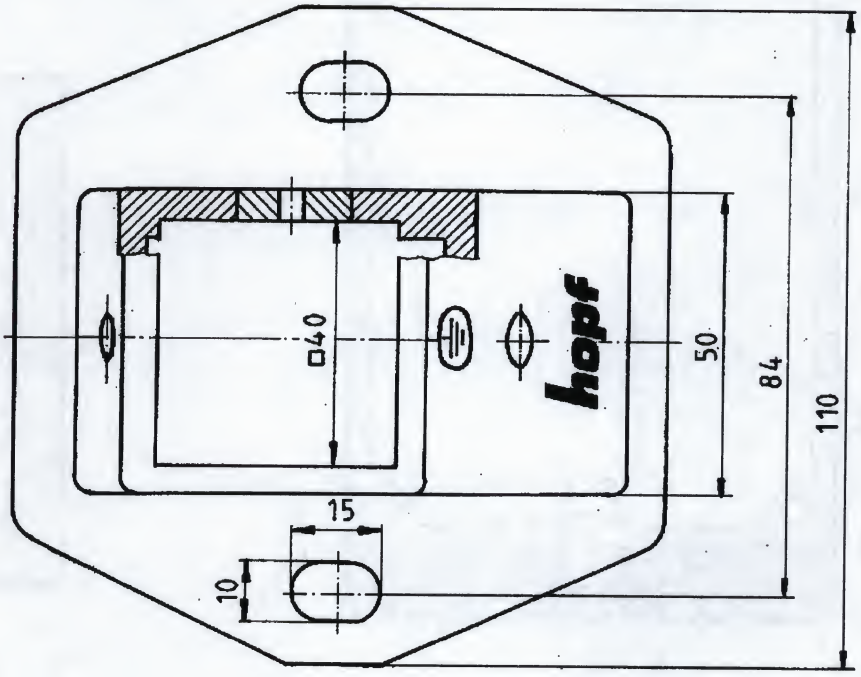

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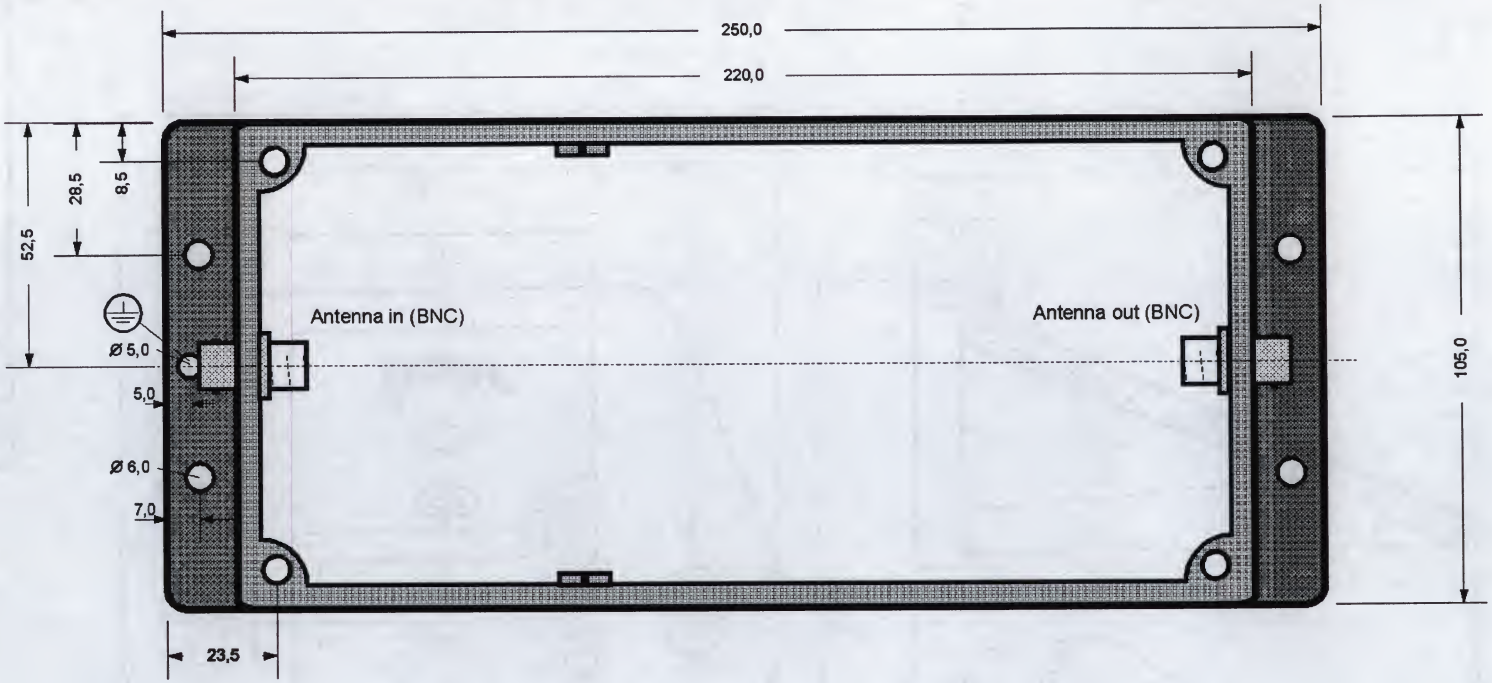
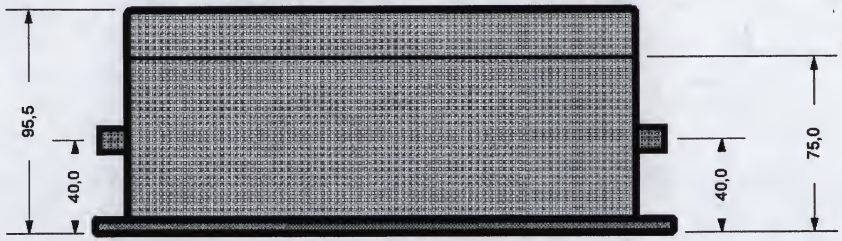
	antenna mounting	
	date 10.04.97	System
	name Vollmer	hopf Elektronik GmbH
	size A4	post box 1847 D-58468 Lüdenscheid fon: (02351) 938686 fax: (02351) 459590





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16.07.97	Vollmer	A4	ZC97071602	1/1

Lightning Protection

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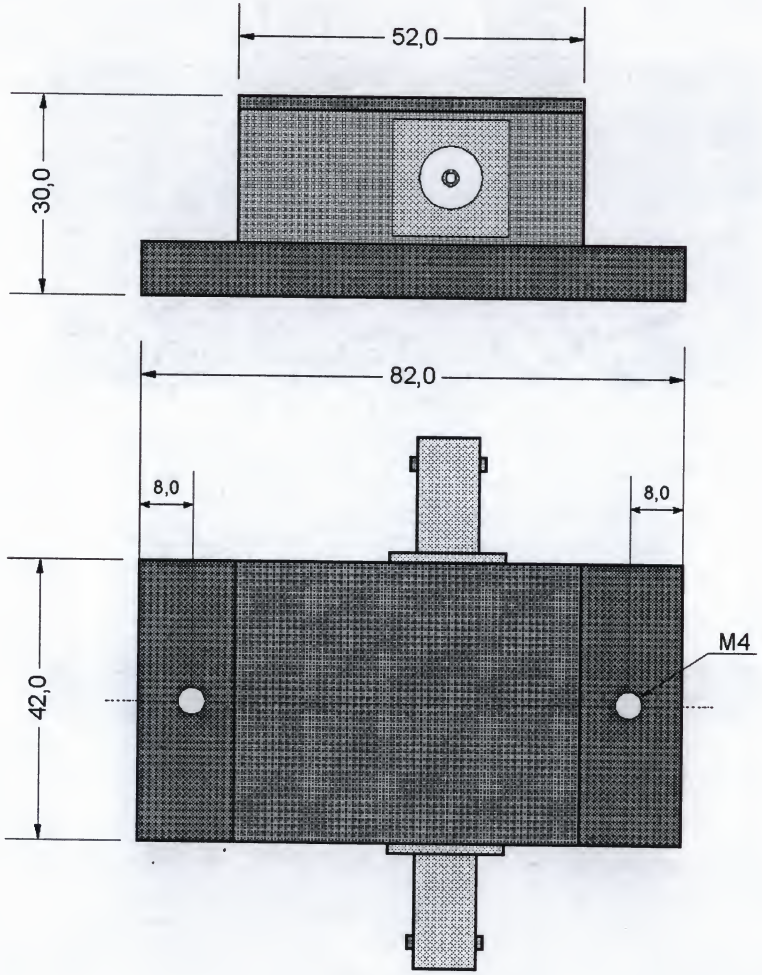

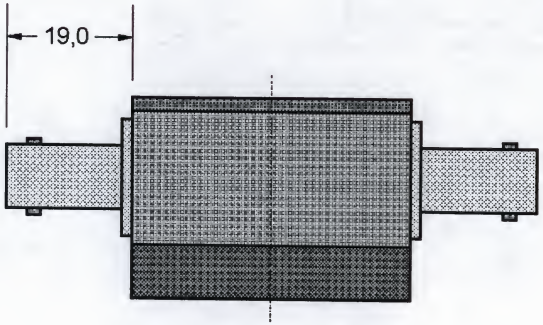

changes			drawing number	ZC98021301	page 1/1
			GPS pre-amplifier		
			date	13.02.98	System
			name	Vollmer	
			check		
date	changes	name	size	A4	

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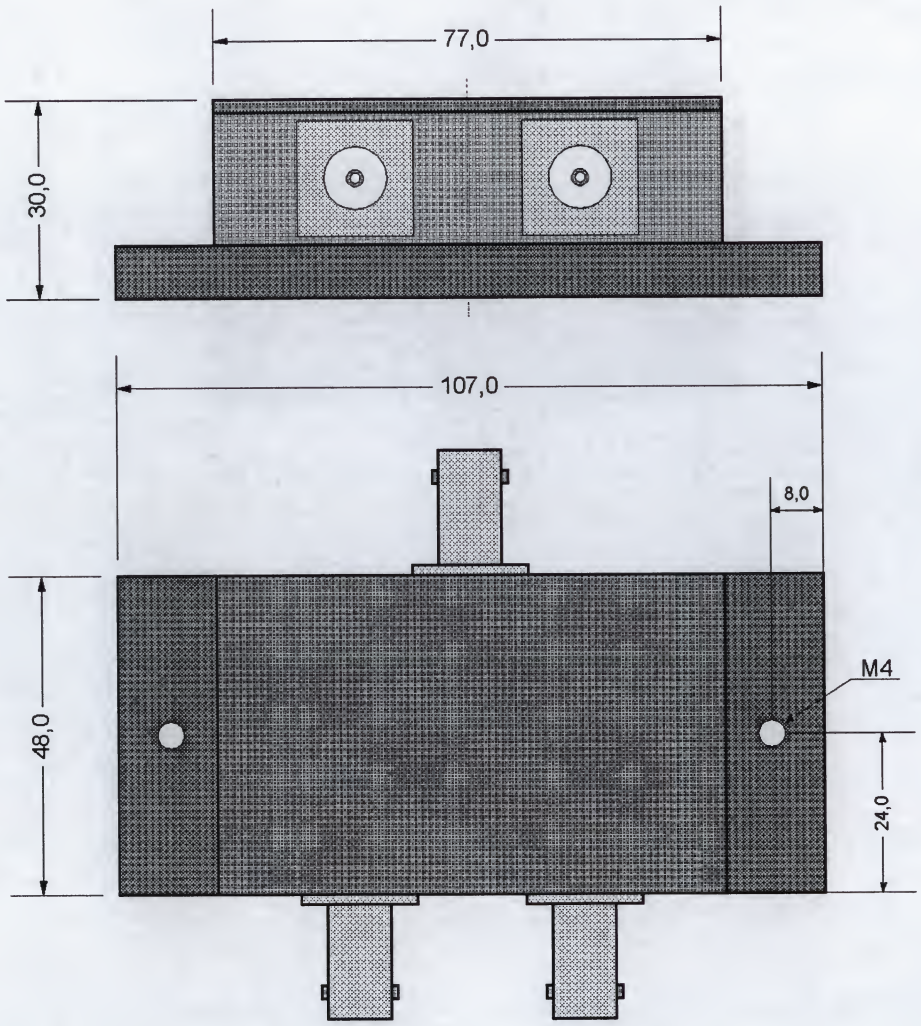

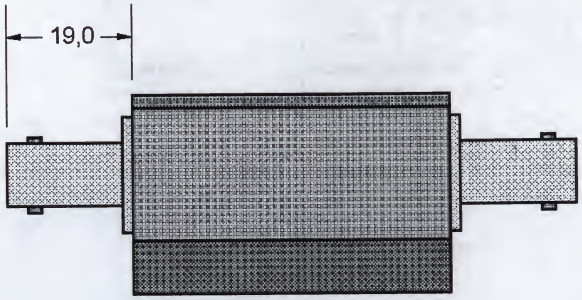

changes			drawing number	ZC98021302	page 1/1
			GPS power splitter		
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			name	Vollmer	
			check		
date	changes	name	size	A4	

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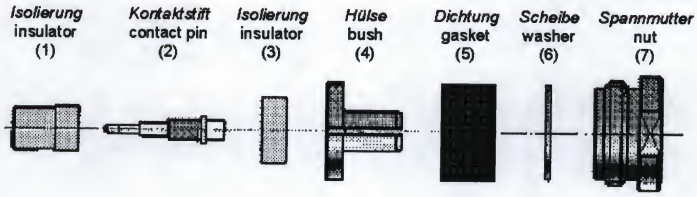
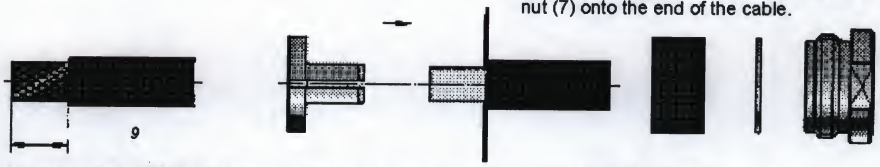
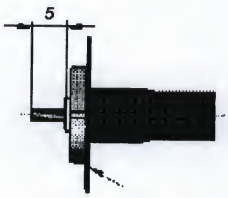


Dichtung (5), Scheibe (6) und Spannmutter (7) vor der Montage auf das Leitungsende schieben.
Before mounting, push gasket (5), washer (6) and nut (7) onto the end of the cable.

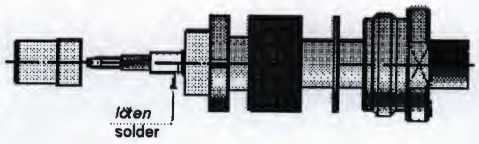


Abisoliermaß für BNC-Stecker
Insulation unit for BNC plug

Geflecht um 90° abwinkeln. Hülse zwischen Folie und Geflecht bis zum Anschlag einschieben. Überstehende Folie mit Messer anritzen und entfernen.
Turn back netting 90°. Insert the bush between foil and netting up to the attempt. Use knife to carefully slit and remove excess foil.



Überstehendes Geflecht abschneiden. Innenleiter abisolieren. Isolierung (3) aufstecken und Kontaktstift (2) anlöten.
Cut of excess netting. Insulate the internal conductor. Mounting insulator (3) and solder on contact pin (2).



Vor dem Aufstecken des Gehäuses, Dichtung (5) bis an die Hülse (4) schieben.
Before mounting the housing, the gasket (5) must pushed up to to the bush (4).

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GPS BNC-plug

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